A HEALTHY BODY

THE NEW HEALTH SERIES OF SCHOOL PHYSIOLOGIES

STOWELL

SILVER, BURDETT & COMPANY

THE NEW HEALTH SERIES OF SCHOOL PHYSIOLOGIES

A HEALTHY BODY

A TEXT-BOOK ON

PHYSIOLOGY AND HYGIENE

FOR USE IN

INTERMEDIATE GRAMMAR GRADES

BY

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SILVER, BURDETT AND COMPANY

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THE NEW HEALTH SERIES OF SCHOOL PHYSIOLOGIES

A PRIMER OF HEALTH.
For Primary and Lower Grammar Grades.

A HEALTHY BODY.
For Intermediate Grammar Grades.

THE ESSENTIALS OF HEALTH.
For Higher Grades.

PREFACE

The recognition so widely and generously accorded to the original edition of "A Healthy Body" has prompted the preparation of this new text, in which all those distinctive features that contributed to the strength and the popularity of the book have been retained.

In offering this new volume the author desires to make no claim to originality of investigation in anatomy and physiology, the simple facts of which have long been fully known. It is in the domain of practical hygiene that our knowledge has increased with such strides during the last few years as to require practically a new statement of those hygienic laws that may be comprehended and followed by the pupil who is old enough to begin to reason and to discriminate. We have also come to a new conception of man's relation to his body, as a living machine wonderfully adapted to the expression of his individuality and his greatest aid in personal development. The old idea that man's body is his enemy and tempter has passed away, and the better and worthier conception of the true relation between the self and the body has but served

to dignify and emphasize the importance of the care of the body.

In treating the effects that alcohol and narcotics have on the body, such facts as are adapted to the comprehension of younger pupils have here been developed in conformity with the latest scientific experiments and discoveries. The plain truths that science teaches on these points have been stated without bias and without the exaggeration of over-emphasis. Other important phases of hygienic teaching have also been given their rightful place in the text.

It is hoped that the illustrative plan of the book will also commend it. It will be found to be remarkably free from anatomical pictures and diagrams of the organs of the body, which, to the child, who comes to this study without previous preparation, are often revolting. As the emphasis throughout the entire book is on the subject of hygiene, much of the usual anatomical illustration is confusing and unnecessary. Wherever it is required to explain the simple physiological facts taught, it is furnished in unexceptionable form. In all, the book contains 52 figures and 24 cuts.

All the requirements of the laws respecting the teaching of the subject of physiology and hygiene in the public schools, as prescribed in the several states, are fully covered here.

Such a text can scarcely do more than suggest to

the pupil those wonders and mysteries of the body that are so little understood and appreciated and so generally ignored. The author's purpose will be accomplished if, through this book, the pupil shall come to recognize the beauty, the delicacy, and the marvelous adaptation of his physical machine, to have a proper appreciation of the care with which it should be used, and to feel that the body is best adjusted when it is controlled by intelligence.

LOWELL, MASS.,
February, 1906.

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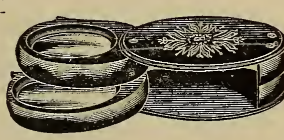
A Healthy Body

CHAPTER I

INTRODUCTION

You have perhaps looked through a magnifying glass and have seen how it makes objects appear much larger. By placing several such glasses in a tube, we can make what is known as a "microscope," and with it we can see objects which we cannot see with the unaided eye. By the use of the microscope we find that every fruit and flower, every blade of grass, is made up of very small parts called "cells."



A Magnifying Glass

Cells in the Vegetable Kingdom.—To further illustrate this, let us examine the inside of a potato. With the unaided eye it looks as if it consisted of one common substance. But the microscope shows that it, too, consists of cells; and in these cells are vast numbers of little grains containing starch, and hence called starch grains.

Using a Microscope

To obtain this starch, cut the potato into thin slices and place these in a small dish full of water. By stirring them you can make the water look milky. Now remove the pieces of potato, and let the water become quiet. A white powder will settle to the bottom of the dish. This is composed of starch grains, which under the microscope appear as small oval bodies.

We take wheat to the miller in order that he may remove some of the outside layers from each little grain, because these layers are not easily digested; and the rest is returned to us as wheat flour. The oatmeal, which we use as a food, is largely composed of grains of starch, and these look very different from the starch grains of wheat or of the potato (Fig. 1). Every part of the vegetable kingdom is composed of cells.

Cells in the Animal Kingdom.—The same thing is true of the animal kingdom. When we look at a

drop of blood we little think that the microscope will show in it vast numbers of very small cells; and yet there are as many as five million in every minute drop. When we look at the skin we see it as one layer of covering; but the microscope shows that it is made up of several layers of cells which differ from one another.

By means of the microscope we learn that every part of the body is composed of minute cells. These

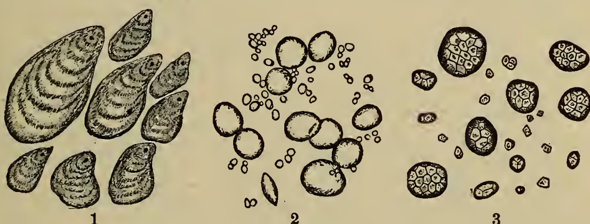


Fig. 1.—Starch grains: (1) from the potato; (2) from wheat; (3) from oats.

cells are not all alike. As shown in Fig. 2, some are round, others long and narrow, while still others are very irregular in shape. Some are so small that it would take many thousands of them side by side to cover an inch in length; while others are so large that they can almost be seen with the unaided eye. Some are colorless, others are light in color, and still others are jet black.

These cells, like the minute parts of some wonderful piece of machinery, are constantly wearing out. Some of them are kept in repair for a long time by a supply of the proper food. Others become completely worn out, are broken to pieces, and

finally removed from the body. In the course of time all cells wear out, and if the body is healthy, are replaced.

Each cell has some particular work to do, and,

FIG. 2.—Cells from different parts of the body: (1) from the inside of the cheeks; (2) from the liver; (3) from the nail of a finger; (4) from the bronchial tubes; (5) from the intestines; (6) from beneath the skin; (7) from muscle; (8) from the eye; (9) from the stomach.

when it fails to do this work as it should, the health suffers to that extent. Should a number of these cells in any one part fail in their duty, that part becomes diseased and may actually die, though the rest of the body remains alive.

Composition of the Body.—Water forms a large part of the weight of the body. There is also a certain amount of fat in the body. We all know that some persons are much more fleshy than others, but even after long-continued illness there is always some fat still remaining in the system. Albuminous substances, of which the most familiar form is the white of an egg, make up a large part of the solid tissues; and are also found in the blood and in some of the other fluids of the body. There is also some mineral matter in the body, principally lime, soda, and potash; there is also some iron, and there are traces of other minerals.

CHAPTER II

THE BONES

General Description.—There are over two hundred bones in the body. Some of them are long, large, and round, while others are thin and flat; still others are so irregular in shape that it is very difficult to describe them. The largest bone in the body is the thigh bone, or femur. See Fig. 3.

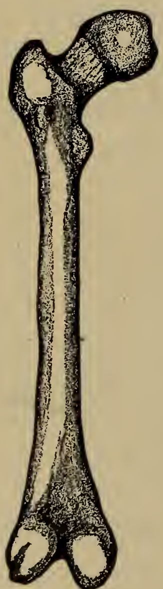


FIG. 3.—The thigh bone, or femur.

Uses of the Bones.—The principal uses of the bones are to act as a support for the softer parts of the body, to give proper shape to the body, and to protect delicate organs that would otherwise be too easily injured. The eye is well protected in this way. It has walls of bone all about it, except in front, where it is necessary for the light to enter. The brain is surrounded by a bony wall, and the heart and lungs are well protected by the bony walls of the chest. Nearly all the bones of the body also have muscles attached to them.

Are the Bones Solid?—This is easily answered by examining one of the large bones of any animal after the bone has been sawed open. If it be sawed lengthwise, we shall find that it is hollow except at the ends. Why is this? It is necessary that the bones be both light and strong. Now a tube, like a straw, is much stronger than the same amount of material would be in the solid form of a rod. Therefore, the large bones are hollow in order that they may be as strong as possible for their weight.

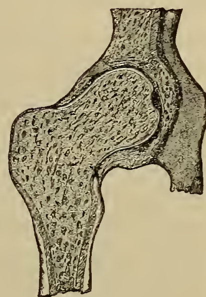


Fig. 4.—A section through the hip joint (reduced). The inside of the end of the femur (A) is seen to consist of loose, spongy bone.

The ends of the long bones are filled with little bands of bone, giving them a honey-combed or spongy appearance, as shown in Fig. 4. If one of the thin, flat bones of the head, or one of the small bones of the hand, should be cut open, there would be found in it this same spongy bone.

The Marrow of Bone.—The large cavity inside the long bones, and all the little spaces in spongy bone, are filled with a yellowish or reddish material, called "marrow." This is largely made up of fat.

Can Bone Bleed?—The bones are well supplied with blood vessels, even the hardest part of the bone having in it a great many small blood vessels. Nearly all these blood vessels are so small that they

can be seen only by means of a microscope (see Figs. 5 and 6); yet if we examine the surface of a large bone of any animal, we can usually find one or more holes through which a blood vessel has passed.

The Soft Part of Bone.—All the black, spider-shaped bodies in Fig. 6 are minute openings or holes, in which are the soft bone cells. Besides these true bone cells there are blood vessels and nerves, and a framework of soft fibres, all going to make up the soft part of bone.

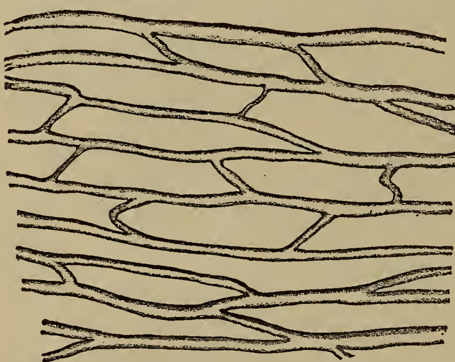


Fig. 5.—A microscopic view of the minute canals in bone, through which the blood vessels pass.

This is called the "animal matter" of bone, and can all be taken out by simply putting the bone into the fire. The shape of the bone will not be changed; it will only become lighter and whiter. After the animal matter has all been burned out, the bone can easily be broken, and pounded into a fine powder.

On the other hand, if we put another bone into a weak acid, we can take out of the bone the "mineral matter" that makes it hard and solid. When this is done, the bone will yet retain

its former shape, although it can then be easily bent.

Broken Bones.—When a bone is broken, the surgeon places the broken ends together, and holds them in position by means of splints and bandages. Nature immediately begins the work of mending the bone. First, a liquid substance forms around the broken ends. This gradually becomes firmer and harder, and in a few weeks develops into true bony structure. Thus the ends become so firmly united that the bone is as strong as ever.

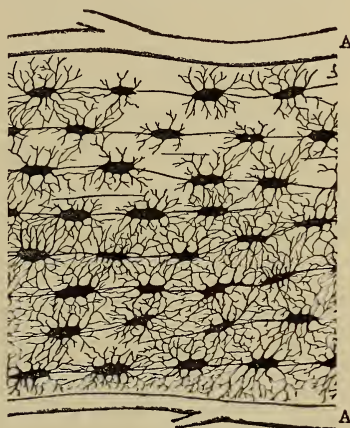


Fig. 6.—A small section of human bone, showing two blood vessels (A A) and a number of spider-shaped openings in which are the bone cells, magnified.

Changes in Bone.—The bones are not fully developed until the person is at least twenty-five years of age. And it should be remembered that even after this they, in some degree, change their soft substance. When the bones have an abundance of animal matter in them, as in early life, they can be moulded, and their natural form can be greatly changed. This is illustrated by the Chinese custom of binding the feet of their young girls until a permanent deformity is produced.

CHAPTER III

THE SKELETON AND THE JOINTS

The Bones of the Skull.—The bones of the skull make a complete covering, or tight box, for the brain, with only a few holes in it to allow the nerves and blood vessels to pass in and out. These bones also protect the organs of sight, smell, hearing, and taste.

Fig. 7.—The spinal column, seen from the left side.

The Spinal Column.—The spinal column (see Fig. 7) consists of twenty-four small bones, resembling that in Fig. 8, and also two irregular bones at the lower end of these. Between these bones, and attached to them, are soft cushions of gristle or cartilage. These cushions act as springs, so that walking, running, and jumping may not jar the body too greatly. If all these cushions could be piled up together, they would make a mass over six inches in thickness, and it would be as elastic as so much rubber. If we walk or stand very much during the day, these cushions

become flattened; but during the night they regain their former thickness. On account of these cushions being so elastic, we are a trifle shorter at night than in the morning. For the same reason we are a trifle shorter when standing than when lying. If it were not for these cushions, we could not run or jump, or even walk, without jarring, and perhaps greatly injuring, either the brain or the spinal cord.

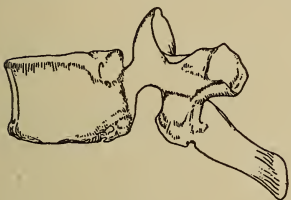


Fig. 8.—Side view of one of the bones of the spinal column.

Each small bone of the spinal column has an opening in it, and in their natural position in the body these openings form a canal in which the spinal cord rests (see Fig. 9). This canal continues unbroken through the base of the skull, and thus we see that the spinal cord and the brain are connected.

The Ribs.—There are twelve slender, curved bones on each side of the chest, called the ribs. Behind, they are all joined to the spinal column, while in front seven of them are joined to the breast-bone, three to each other, and two are not joined in front to anything, hence these two are called the "floating ribs."

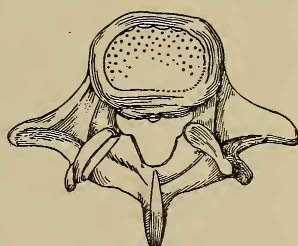


Fig. 9.—Bone of spinal column, viewed from above.

The Breast-Bone. — The breast-bone (also called the sternum) is a flat bone in the middle of the front part of the chest, and is the bone to which most of the ribs are attached in front.

The Arms. — There are five large bones and several small ones that belong to the arm.

The collar-bone (the clavicle) extends from the front of the shoulders to the top of the breast-bone.

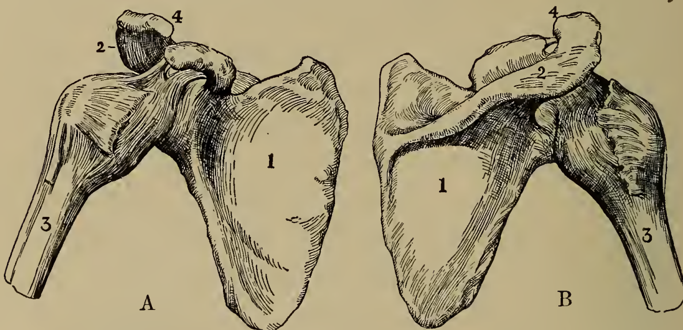


Fig. 10.—(A) Front view of the right shoulder-joint, without collar-bone. (B) Back view of the same joint.

(1) Scapula; (2) bony prominence on scapula; (3) humerus; (4) point of attachment of collar-bone. The ball (head) of the humerus is held tightly to the socket of the scapula by means of ligaments here shown.

The shoulder-blade (or scapula) is behind the arm and between it and the spinal column. The meeting of the shoulder-blade, the collar-bone and the upper end of the arm bone make the shoulder (Fig. 10).

Between the shoulder and the elbow there is one large bone, called the humerus. Between the elbow and the hand there are two bones. The bone on the thumb side is the radius, the other is the ulna.

A number of small bones form the wrist and the hand, and these allow a variety of movements.

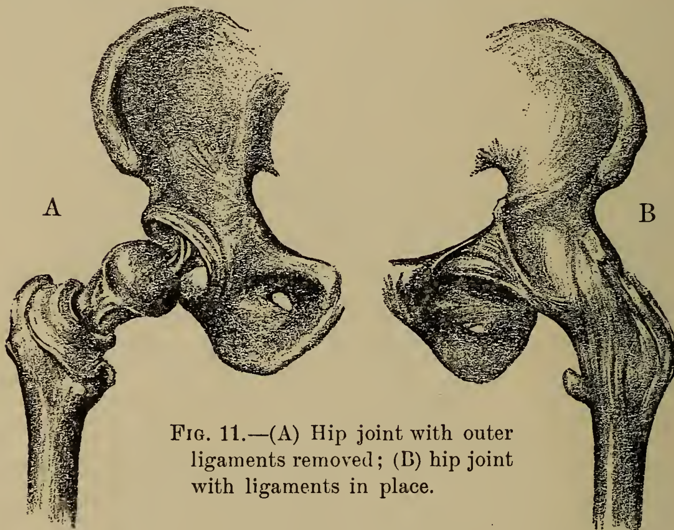
The Legs.—The bones of the legs are much like those of the arms,—one large bone between the hip and the knee, called the femur, and two smaller ones between the knee and the foot. The bone prominent on the front of the leg is called the tibia, the other bone is the fibula. A small round bone, called the "knee cap," covers the knee joint in front. The legs are attached to the pelvis at the hip joints; the pelvic bones can be felt on the sides of the lower part of the trunk.

There are a number of small bones in the feet, arranged, as in the case of the wrist and the hand, so as to render a variety of movements possible.

The Joints.—There may be only two, or there may be several, bones forming a joint. The hip joint, which is shown in Fig. 11, is one of the most interesting of the different forms of joints. On the ends of the bones which come together to make a joint there is a kind of gristle called "cartilage." This is covered with a very thin membrane which is constantly secreting, or pouring out, a watery substance. This "joint water" serves the same purpose that oil does upon the joints or bearings of machinery.

The Ligaments.—The bones are held in place at the joint by means of white, shining bands of tissue called "ligaments." See Fig. 11. A "sprain" is an injury to the ligaments.

Tight and Loose Joints.—The ligaments of some persons are very firm, and the joints are not easily moved. In others the ligaments are not so firm, and the joints are more easily moved. We say of these latter that they are "loose-jointed." When a



A B

Fig. 11.—(A) Hip joint with outer ligaments removed; (B) hip joint with ligaments in place.

bone gets "out of joint," it breaks its way through these ligaments.

Different Kinds of Joints.—Most of the joints are either "ball-and-socket" joints, or "hinge" joints. The hip and the shoulder are good illustrations of the "ball-and-socket joint," for they allow movements in every direction. The elbow is an illustration of the "hinge" joint, because, like the hinge of a door, it allows movements only in two directions.

CHAPTER IV

THE CARE OF THE BONES

We have already learned that the bones of a young person are easily bent because there is so much animal matter in them. So it is possible, simply by improper ways of walking and sitting, to deform the body and make it crooked and irregular.

A Correct Standing Position

How to Have a Good Form.—If we wish to have a fine, erect form, we must endeavor to keep the bones of the spine in their natural position. If we do this when we are young, and when the bones are daily becoming more solid, then when our bodies are well developed we shall find that an easy, erect position in sitting and in walking is the natural one for us.

How to Walk.—To keep the spine in its natural position we should walk with the body erect and

with the chest held high. If a person gets in the habit of "stooping" when he walks, or of sitting at the table "all bent over," the elastic cushions between the spinal bones, even the bones themselves and some of the muscles attached to them, may become so changed that when he tries to straighten up, it is hard to do so; he is "round-shouldered." To get straight again, he must take exercises that will undo the damage done.


AN INCORRECT STANDING POSITION

Straight, or Crooked.—Let us look at two persons. One stands as "straight as an arrow"; he sits upright at his table or desk, and people say, "What a fine form!" We should not pick out such a person as likely to have consumption, for he "looks so healthy."

The other person is round-shouldered, his chest is narrow, it is an effort for him to run or jump, and he is subject to coughs and colds. We wish to tell him to "straighten up," but he would have to work long and patiently to do it now, for the bones are well filled with mineral matter, and the elastic cushions are unyielding. In youth we should

throw off any inclination to stoop; and should sit, stand, and walk in proper position, that we may make sure of having a good form and a healthy body.

How to Stand.—When some persons stand they rest their weight on one foot; this habit is sure to make the hip bones grow out of shape. It will bend the spine, and, sooner or later, make it incline toward one side. As a rule, it is better to stand with the weight of the body on both feet. To do this, one thing is certainly necessary—shoes that are comfortable.

ONE CORRECT FORM OF SITTING AT ATTENTION

Proper Shoes.—When buying shoes it is customary to have them fitted while sitting on a chair or couch, and the dealer is cautioned "not to get them too large." So a snug fit is made. When the person stands and the weight of the body is thrown on the feet, the arch of the foot is flattened, and the foot thereby lengthened. The shoe that was "snug"

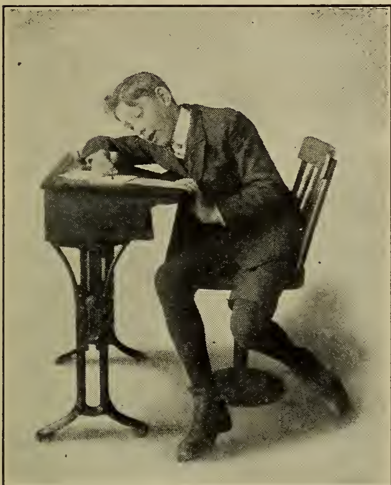
before, is now too small, and great discomfort and possible harm follow. These consequences will be all the more marked if the shoe be made with a high heel. A high heel throws the whole body out of line, and is the cause of a number of most distressing complaints. The low "common-sense" heel is far better and much more comfortable. We hope our young friends will always choose it, showing by their choice that they care more for a healthy body than for passing fashions.

A Good Position for Desk Work

Support for the Feet.—In all schoolrooms the seats should be low enough to let the pupil's feet rest on the floor. It is injurious for children to sit long without a support for their feet.

Things to Avoid.—If we remember that the bones are filled with blood vessels, nerves, and cells, and that these cannot be in a sound condition unless they are fed with healthy blood, we can readily understand, when we come to study about the effects of alcohol, that it has the power to hinder the growth of this important part of the body.

The early use of tobacco, also, may seriously affect the proper development of the bones. Indeed, it may be put down as a very general rule that the use of tobacco and alcohol by the young may so affect the growth of the bones as to dwarf the whole body.

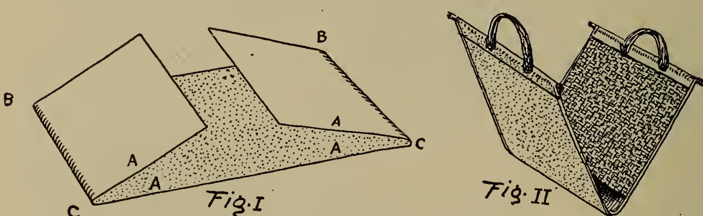


A Bad Position for Desk Work

Carrying School Books.—Boys and girls usually have some home study books to carry back and forth from school; and they too often carry them in ways that are harmful. Notice for a day what the pupils in your school do with the books they are taking home. You will probably find that many put them in a strap slung over one shoulder, much as the boy in this illustration is carrying his. Notice how badly his shoulders are twisted because the

Books Should Not be Strapped and Carried Like This

weight of the books comes on one side. If he carries them in this way, month after month, he will be likely to find that his shoulders are growing misshapen. But books must be carried, and it is often not convenient to balance the body properly by carrying an equal lot of books on each arm. The next best plan is to carry the books either in a detached strap or in a bag, which can readily be shifted from one hand to the other. A bag serves also to keep the books clean, and in wet weather it keeps them dry. The illustration shows how a very simple and inexpensive school bag can be made.



A Good School Bag

Figure I shows the foundation of the bag, a strip of denim, 51 inches long and 14 inches wide. It is first folded 12 inches from each end on the edges B C. The edges A A are then sewed together, also the corresponding edges on the opposite side. This gives two pockets, each with an opening in the middle. For handles, a round hard-wood stick is passed inside the two folds at B C. Handles of leather or webbing are sewed to the goods under the sticks. Figure II shows the finished bag.

CHAPTER V

ALCOHOLIC DRINKS

Custom has brought about an extensive use of a class of drinks whose nature is little understood by those who first begin to take them. The most common of these drinks are beer, wine, cider, gin, rum, whiskey and brandy. The principal substance which makes these liquors intoxicating and dangerous is alcohol. The chief danger in alcohol is that it has the power to create in those who take it an almost irresistible craving for more.

What is Alcohol?—Alcohol is a liquid that is lighter than water, and colorless. It burns readily, giving very little light and no smoke, but a great deal of heat.

Alcohol is a poison,—that is, a substance whose nature it is, when absorbed into the blood, to injure health or to destroy life. This does not mean that all forms of alcoholic drinks are immediately fatal, although numerous cases are on record where alcohol in the form of whiskey or brandy has quickly destroyed life. Pure alcohol is not ordinarily used as a beverage; it is taken in the form of some spirituous liquor in which it is more or less diluted.

Yet the nature of the alcohol is not changed by dilution.

How Alcohol is Formed.—In ripe fruits, like the grapes and apples, there is a large amount of juice which consists chiefly of water and sugar. By crushing these fruits and pressing out their juice a sweet liquid is obtained. When this sweet liquid is exposed to the warm air, bubbles will soon be seen rising to the surface, while the juice will begin to have a sharp, stinging taste. It is evident that some change has taken place in the liquid. This change is called "fermentation." There are various forms of fermentation. That which produces alcohol is called "alcoholic fermentation."

What Causes Fermentation.—When we look closely at ripening fruit, it usually appears to be covered with a kind of dust often called the "bloom" of the fruit. In this dust are minute plant cells which are plentiful in the air and on the skins and stems of fruits about the time they are ripening. These plant cells have been called ferments, since they are the cause of fermentation. There are many kinds of fer-

ments. Those that cause alcoholic fermentation in pressed-out fruit juices are very much like the plant cells found in bakers' yeast. For this reason they have been called "wild yeast plants." When yeast plants are examined by the aid of the microscope, they are seen to consist of minute cell-like bodies, belonging to the vegetable kingdom. Each cell must be regarded as a complete plant, although it would require 3,000 of these cells in a line, side by side, to cover a single inch.

As long as the wild yeast plants are on the outside of the fruit and cannot reach the sweet juice within, they do no harm; but when the apples or grapes are crushed, as in the making of cider or wine, the yeast plants on the surface are washed into the juice and immediately begin to attack the sugar, breaking it down and forming two new substances,—carbon dioxide, which is a gas, and alcohol.

Cider.—Cider is a drink made from the juice of apples. When the juice is first pressed from the apples there is no alcohol in it, but if it is exposed to the warm air it will begin to ferment in from

six to eight hours. We now understand why this is so, for the yeast plants which are present in large numbers on the skin of the apple are mixed with the fresh juice in the process of crushing and pressing.

Fermentation in cider-making is often hastened because frequently there is, mixed with the freshly pressed juice, a little remaining in the mill from a previous grinding, and in this juice there is an extra quantity of the yeast ferment in an active condition. No one would make any objection to the use of fresh cider if it could be obtained before it had fermented; but it is almost impossible to procure it in that condition. The yeast plants are present in sweet cider in such large numbers and they are so active that some fermentation soon takes place. In a short time after the juice has been pressed from the apples and left in moderately warm air, a difference can be noticed in the taste of the cider. The new taste is due to the change of the sugar into carbon dioxide and alcohol. An appetite for stronger liquors can be easily formed from cider-drinking.

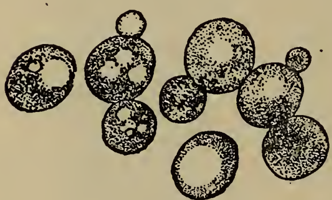


FIG. 12.—Yeast plants highly magnified.

Wine.—When such fruits as grapes and currants are crushed and their juice pressed out, yeast germs are washed from their surfaces into the

juice, where they soon begin to change the sugar into carbon dioxide and alcohol. The liquid is then called wine. The amount of alcohol in wine depends partly upon the amount of sugar the ferments find in the juice. After a certain amount of alcohol has been produced it stops the growth of the ferments and may even kill them.

It is the alcohol in wine that makes it a dangerous drink. A wine may be home-made and free from any poisonous drugs that might be added to give it color or taste, yet if it has fermented it contains alcohol, which is a poison, and for this reason it should be shunned. Every year thousands go down to drunkards' graves because they thought they would not be harmed by taking a little wine or beer or cider. Thousands more who do not become drunkards die of diseases they might have resisted if they had not undermined their health by the use of these alcoholic drinks.

Beer.—The solid parts of most ripe grains, such as corn and barley, consist almost entirely of starch. If these ripe grains are moistened and kept warm, they will soon begin to grow or "sprout." During this growth the starch in the grains is changed to sugar. In beer making, this sugar is easily obtained from such sprouted grains by crushing them and adding water to the crushed mass. The water will dissolve the sugar, and by drawing the water off, a sweet liquid is obtained. To this are added

hops, which give a bitter flavor, and yeast to produce alcoholic fermentation. The carbon dioxide which is formed escapes, but the alcohol remains mixed with the liquid. Ale and porter are made in a similar manner.

The reason that beer and other malt liquors are unsafe drinks is because they contain alcohol, which has the power to give the drinker a craving for more. The idea that there is no harm in a glass of beer is a mistaken one. The habitual use of beer as well as of other alcoholic drinks tends to injure the health and the character of the drinker.

Other Ferments.—Beside yeast there are other ferments, as the mould often seen on old bread, cheese, leather, and other objects. There is also a class of minute germs called "bacteria," which are so small that the highest powers of the microscope must be used in order to see them. And yet so carefully have these been studied that it is now possible to classify them and often to tell precisely what work they do.

Alcohol is Changed in Making Vinegar.—The fermentation which produces beer, wine, or cider from the action of the yeast plant on sugar is called alcoholic or vinous fermentation. When this has gone on until the sugar in the fermenting liquid is all changed, or until the ferments are themselves killed by the alcohol they have produced, the alcoholic fermentation ceases. Then another ferment, which

is a kind of bacteria, enters, and begins to change the alcohol into acetic acid. This fermentation changes wine or cider into vinegar. Vinegar is used to flavor food, and is a marked illustration of how ferments change the substances upon which they work, as from the sweet juice of the apples we may at last have a sharp acid.

A Universal Law.—Fermentation entirely changes the nature of the substances upon which it works. We see this repeatedly illustrated. The juice of ripe fruits will not burn, neither is there anything in it that will intoxicate. The grape is wholesome until it begins to decay. So also is its juice wholesome while it is in the ripe fruit; but it is quickly changed after being pressed out and exposed in warm air to the action of the yeast ferments. Milk is wholesome, but if it is left in the warm air, ferments act upon it and it becomes sour. Beef is wholesome, but if we use it as food after the bacteria have caused its decay, we may suffer severely.

From this we learn that although beer is made from wholesome grain it is not necessarily a healthful drink. Alcohol is the result of a fermentation which changes the nature of the substance upon which it works.

The Alcoholic Appetite.—As in the case of opium and some other poisons, the alcohol in beer, wine, cider, or in any such liquor, has, as we have seen,

the power to create a desire for more. When we are thirsty a small amount of water will satisfy us, and the next time no more water will be required than before. But with alcohol it is different. A little has the power to create a desire for more; and this desire is likely to increase as the system comes more and more under its influence. No one can foretell how much resistance he may have against alcohol without taking a risk that may ruin his life. Instances are on record where a person having such an appetite has been able to hold it in check for a long time, and then one drink, or an accidental taste of an alcoholic liquor, has aroused an irresistible craving that has led to swift destruction. To escape the mastery of alcohol, all drinks that contain it, even in small quantities, should be strictly avoided. Even such light drinks as fermented cider and home-made beer should be shunned, as well as desserts flavored with brandy or wine. They all contain a certain quantity of alcohol, and although this amount may be small, yet wherever alcohol is, there danger lurks.

Many persons begin the use of alcoholic liquors determined to be only moderate drinkers, but they often find, when it is too late, that alcohol has created a craving that is stronger than their desire to resist. Here lies the great difference between practicing moderation in the use of ordinary food and drink, and trying to be moderate in the use of alcoholic

drinks. It is reasonable to expect that by cultivating and exercising proper self-control one can easily resist the temptation to overeat or to drink too much milk or lemonade. But attempting to exercise self-control in the use of alcoholic drinks is quite different, because alcohol has the power to weaken self-control. Ordinary food and drink have no such power.

Alcoholic drinks are not necessary to the highest success or enjoyment. By refusing them no one loses the respect of any person whose good opinion is worth retaining. With this as with temptations to all other forms of unwise or improper indulgence, moral courage and character are strengthened by resisting, but weakened by yielding.

How Fast Will It Grow?—The alcoholic appetite does not grow equally fast upon all persons. It comes upon its victim before he is aware. No one intends to become a hard drinker when he first drinks beer or wine. As a rule that is done thoughtlessly. But it is this peculiar power that alcohol has of creating an appetite for its increasing use that leads to ruin.

Whom It Will Affect.—Although persons of an active, generous and sensitive nature seem to be more quickly and more seriously affected, yet none are sure of escape. It may overcome persons of all ages, sexes or dispositions and in all conditions of life. It harms the young more in comparison than

it does grown persons, because the growing body is less able to resist all injurious influences than the body whose strength is no longer needed for growth. But danger from the use of alcohol does not cease when the youth becomes a man. Out of sixty-five drunkards who were recently questioned on this subject, eighteen, nearly one-third, stated that they took their first glass after they were twenty-one.

It is not wise for any one to think that he would be stronger to resist a craving for alcohol than others have been who have failed to do so. A noted German professor of hygiene* says that no one can foretell whether or not he is susceptible to alcohol. He finds out only by playing a game of chance with his life, which is a dangerous experiment.

Yeast in Bread-Making.—If yeast is a ferment which can so quickly produce alcohol from a sweet mixture, why is it that there is no alcohol in bread? It is true that in both cases alcohol is formed, but in the first case the alcohol remains in the substance used, while in the second case the alcohol escapes. In making bread, yeast is added to the moistened flour. This yeast acts upon the small amount of sugar present, changing it into carbon dioxide and alcohol. The gas becomes imprisoned in the sticky dough, making a great number of larger or smaller openings.

*Professor Max Gruber, president of the Royal Institute of Hygiene at Munich.

These cause the bread to be light and porous. As the bread is baked, the heat in the oven causes the small amount of alcohol to evaporate, and it passes out of the bread, together with the gas.

WHAT IS THE DIFFERENCE ?

In Making Bread	In Making Beer
1. Starch.	1. Starch.
2. Sugar.	2. Sugar.
3. Yeast.	3. Yeast.
4. Alcohol and carbon dioxide.	4. Alcohol and carbon dioxide.
5. The alcohol is *evaporated.*	5. The alcohol is *retained.*
Result	
A valuable food free from any poison.	A drink containing a dangerous poison.

THE AMOUNT OF ALCOHOL IN FERMENTED LIQUORS

In 100 parts of	cider	there are from	5 to 7	parts of alcohol.
" " " "	beer	" " "	5 to 7	" " "
" " " "	wine	" " "	10 to 20	" " "

CHAPTER VI

THE MUSCLES

Their Number, Size, and Purpose.—There are more than five hundred muscles in the body, nearly all of which are arranged in pairs, so that the two sides of the body are almost alike. Some of these muscles are very small and short, while others reach from the hip to the knee. Their principal use is to move the different parts of the body; but they also aid in giving proper shape to the body, and in enclosing cavities,—as the mouth. Nearly half the weight of the body is due to muscle.

Two Kinds of Muscles.—The muscles are divided into two classes,—the voluntary and the involuntary.

We can move some muscles whenever we wish, as, for instance, those of the face and the arm. Because we are thus able to control their movements, they are called voluntary. But some muscles cannot be controlled in this way. They do their work whether we wish it or not. We cannot control their movements by the will, so they are called involuntary. The muscles of the stomach and the heart are of this variety. The heart beats and the stomach contracts, and we have no power to stop them.

The Uses of Muscles.—Nearly all the voluntary muscles are attached at each end to bone; it is because they contract and move the bones that we are able to run and jump and perform all the movements of which the body is capable.

Two Parts of a Muscle.—The muscles that are under the control of the will consist of two parts,—the large red portion, called the body; and the white shining cords, called the tendons, which attach the ends of the muscles to the bones.

The Tendons.—The tendons are easily seen by examining the muscles, or flesh, on the leg of a fowl, after the removal of the skin. They can also be felt at the wrist when the fingers are moved.

Fig. 13.—The muscles of the arm, ending in the white tendons at the wrist.

Nearly all the muscles of the fore-arm end in tendons near the wrist. The tendons are fastened to the bones of the fingers, so that when the muscles of the arm or fore-arm contract, they draw these tendons, and thus move the fingers.

Size of the Tendons.—The tendons are always much smaller than the muscles to which they belong. This is well illustrated in Fig. 13. The muscles at the middle of the fore-arm, as shown in the figure, are quite large, while the tendons at the wrist are so small that you can reach around the

wrist with the thumb and finger. This makes the movements at the wrist more free and easy.

The largest tendon in the body is attached to the heel. Its muscle forms the fleshy part of the back of the leg. When that muscle contracts, the tendon draws up the heel.

The muscle is the active part; the tendon is only a cord which can be pulled by the muscle.

The Structure of Muscle.—If a piece of boiled, lean

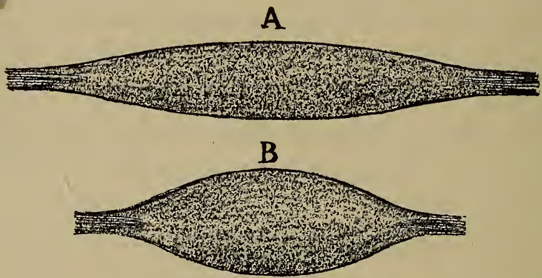


FIG. 14.—A, a muscle relaxed; B, the same muscle contracted.

meat, which is voluntary muscle, be examined, it will be seen that it readily falls apart into little threads of tissue; and with needles these little threads may be easily divided into still smaller threads. If one of these small threads is placed under the microscope it will be found to consist of many still smaller threads. Therefore we say that voluntary muscle is made up of many small threads, all bound together.

Involuntary muscle is composed of very small cells which are placed close together.

The Contraction of Muscle.—The muscles are of use to us because they have the power to contract.

When a muscle contracts, it becomes thicker, harder, and shorter; notice Fig. 14. That it becomes harder and thicker is easily shown by pressing the thumb on the end of the little finger, and placing the fingers of the other hand on the ball of the thumb. It can also be shown by placing the hand on the front of the upper arm and raising the fore-arm; the muscle will be felt to swell and harden.

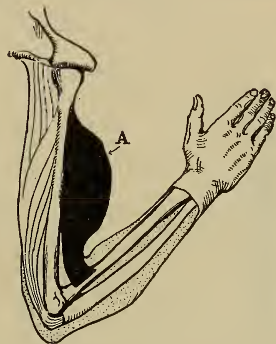


FIG. 15.—A, the muscle in the front of the arm (the biceps), contracted; raising the fore-arm. FIG. 16.—B, muscle in the back of the arm (the triceps), contracted; drawing the fore-arm down.

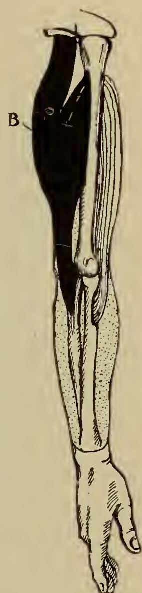


FIG. 16.

That the muscle shortens, is proved by the fact that it moves the parts to which it is attached. All the movements of the body are made by the contraction of its muscles.

The two diagrams above show how the contraction, or shortening, of the muscles causes the parts to which they are attached to move. In Figs. 15 and 16 it is clear that when the muscle on the front of the arm contracts, the fore-arm and the hand

are raised; while when the muscle on the back of the arm shortens, it pulls on its tendon and the fore-arm and hand are drawn down again.

This principle is again illustrated in Figs. 17 and

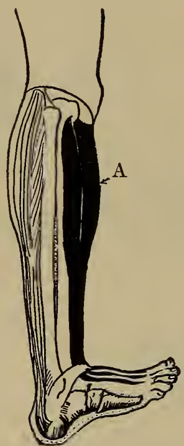


FIG. 17

A, muscle on the front of the leg (the tibialis) contracted, which raises the foot.

FIG. 18

B, muscle on the back of the leg (the gastrocnemius) contracted, which raises the heel and thus draws down the foot.

18. It is clear that when the muscle on the front of the leg shortens, it pulls on its tendon and raises the foot; while if the muscle on the back of the leg shortens, it pulls on its tendon and raises the heel. These illustrations show the principle on which all the voluntary muscles act.

CHAPTER VII

EXERCISE

Exercise of the Muscles.—If a person should place his arm in a sling and not use it for a few months, it would gradually become smaller and smaller. The arm would become smaller because its muscles would not be properly nourished. Indeed, after a few months, some of the muscles might disappear. On the other hand, when muscles are properly exercised, they become better nourished and this makes them larger, harder, and stronger.

Exercise is Necessary.—It is absolutely necessary to exercise the muscles, if we wish to keep them healthy and strong. Exercise makes the blood circulate better; so it follows that when we are exercising our muscles, we are also giving a better circulation to the blood in the brain and in the other organs of the body.

Over-Exercise is Bad.—Still, over-exercise is nearly as bad as no exercise. It is not a good practice to play or exercise in any way until one is "all tired out."

Exercise all Parts of the Body.—We should not exercise any particular part of the body to the neglect

of any other part, but we should endeavor to develop all parts equally well. No one admires a man who has very strong muscles but an inactive brain; neither do we like to see one who is very

VACATION SCHOOL BOYS TAKING REGULAR EXERCISE OUT-OF-DOORS

learned, and yet has a weak, sickly body. Therefore, if we have been studying all day, a brisk walk in the evening will make us feel refreshed; while if we have been using the muscles at hard work during the day, reading or studying is the proper exercise.

Expression.—The various expressions of the face are caused by the contraction of voluntary muscles;

and as a muscle is strengthened by exercise, so it follows that those muscles of the face which are used the most will become the strongest.

If the muscles we use when we laugh are made to contract very often they will become stronger

A Girls' Model Class in Light Gymnastics

than their neighbors; so that even when a person is not thinking of laughing, these muscles will exert an influence. As a result there is a slight expression of laughter left on the face. We say such a person has a pleasant smile all the time. If a person cries a great deal, there will be left a slight expression of crying. We say such a person has a sad face. If a person is in the habit of being cross and sullen, it will leave its effect on the features.

So we see that the expression which is most often on the face will after a time become lasting. This is the reason why it is possible to tell the disposition of a person by the expression of the face.

Do you wish to have a hard and ill-natured face? Then while young fill the mind with hard and ill-natured thoughts. Do you prefer a face that shows kindness and honesty? Then cultivate a pleasant disposition, show kindness, and be honest to all. Let the mind be filled with only those thoughts which are true and noble and kind.

General Exercise.—Exercise should be taken out of doors as much as possible, since pure air is of the greatest importance.

Any exercise is too violent which leaves the body exhausted. It not only makes one unfit to do work of any kind, but also is likely to injure the nervous system. Healthful exercise causes refreshing sleep, brings a restful feeling and, after rest, a desire to work.

When and How to Exercise.—We should not exercise vigorously either just before or just after a meal. We should take some kind of exercise each day. Walking to and from school is not enough, neither will it do to study all the school days, and then play all day Saturday.

Baseball, basket ball, and lawn tennis are good for the summer days; the sled, the skates, and snowballing make good sport for winter.

The Muscles Must Rest.—The muscles need rest, and nearly all of them get complete rest when we sleep. But the heart, which is a great hollow muscle, keeps beating away during the night as well as during the day. Yet we shall learn that it, too, has its time of rest.

AN EXCITING MOMENT IN THE GAME OF BASKET BALL

Jumping Rope.—This form of sport is very injurious when it is carried to excess, as is frequently the case. Jumping rope is in itself a good exercise; but it seems to make even sensible girls careless and reckless. We see them trying to find out how many times they can jump the rope without resting; this often results in temporary illness, and sometimes in permanent injury to the nervous system.

Alcohol and Muscle.—Men have given a great deal of time to finding out just what effect alcohol has

on the muscles of the body. They know that if we take good, nourishing food, when we are hungry and the body is weak, we feel strong again. They know, too, that we cannot at once make ourselves strong by eating a great deal.

Let us think of a man who is hard at work in a shop, using his muscles many hours each day. He eats three hearty meals a day, and feels well and strong. Now suppose he wants to work twice as hard as usual some afternoon. Do you think he could do it more easily if he should eat two big dinners? Most certainly not.

But when men began to use alcohol, they said: "Here is something that will allow us to work twice as hard as usual, and will not let us get tired."

Is this true? Does alcohol actually make one stronger? Does it help one to do more work, without suffering from it in any way? Let us think a moment before we answer.

Have you ever been very sick? If so, when you were getting better, and were once more walking about, you may have felt as well and strong as ever, yet when you attempted to lift anything, or to run, you found then that your feelings were no safe guide. You were weak, and could not do what you expected.

Now, our workman in the shop tries a glass of something that contains alcohol, it may be beer, whiskey, or brandy, and he says that it makes him

feel so much stronger. The real question is this: Is he any stronger? Are his feelings a true test?

It is proved beyond a doubt that when the system is under the influence of alcohol, the muscles will not contract as strongly as before. The workman is not made stronger by his glass of liquor. He may feel as though he could do more work, but when put to the test, he cannot do as much as he could without the liquor. The effect of alcohol varies with different individuals. Small amounts with some persons may increase the action of the muscles for a short time; but the sum total of work done under the influence of alcohol is less than that done without it.

It is said that some forms of drink, such as beer and ale, make the muscles larger. They certainly do tend to make some persons grow fat, but this is very different from growing strong. To load the body with a great quantity of fat is positively injurious. Beer and ale tend to make an excess of fat. This hinders the proper action of the muscles, and may seriously interfere with the action of many other parts of the body.

As a rule, very fleshy people are neither so strong, nor so healthy, as those who have less fat, and more hard muscle.

CHAPTER VIII

OUR FOODS

Varieties of Food.—Some animals appear to be almost constantly taking small quantities of food. The common canary bird keeps very busy cracking seeds, and swallowing the kernels. Others eat enor-

A Squirrel Enjoying a Meal

mous quantities of food at one time, and afterwards lie quiet, and perhaps sleep for days. Still others, as the dog, do not chew their food, but simply tear it just enough to enable them to swallow it. The cow gathers the grass very fast, and swallows it quickly. Then, while resting, she brings the food back to her mouth and thoroughly chews it. Some

animals can live on only one kind of food. The horse lives on grass, fresh or dried, and on grain; never eating meat of any kind. The squirrel likes the kernels of nuts, and does not care for grass. But man uses food from all three kingdoms, the vegetable, the mineral, and the animal.

The Purpose of Food.—As the movements of machinery tend to wear it out, so every motion of the body causes some portion of it to wear away. Food is needed to furnish new material to take the place of that which is worn out. The body of a young child is much smaller than the natural size of the man or woman. The child has gradually to build for himself a larger body. This we call growth. Food is needed to furnish building material for the growing body. The human body cannot live or grow unless it is kept warm. The warming of the body corresponds in some respects to the warming of a room. We put wood or coal, which we call fuel, into a stove or furnace and burn it. In burning, the fuel gives off heat, which warms the room. Food is needed to serve as fuel for warming the body.

You have seen the flames of burning wood, and the red glow of burning coal, and perhaps the word "burning" means to you always a flame, or a red glow. But there are other kinds of burning. Perhaps you have seen cold water thrown upon lime, which, as it united with the water, began to bubble and send off heat. Here a wet mass, with no red flame or glow,

gives rise to heat. In this respect the burning of food in the body is more like the union of lime and water than it is like the burning of wood and coal, but the heat produced is not so great.

The burning of food in the body is called "oxidation." Food furnishes the material for this oxidation which keeps the body warm and gives it strength and energy for work. A horse that is well fed comes out of his stall full of energy, eager to use his muscles, while the poorly fed horse is weak. Food is needed by all animals to supply them with energy for their proper work.

The twofold purpose of food is (1) to supply the body with building material for growth and for the repair of waste; (2) to give it fuel for warmth and for working power.

Any material which acts contrary to these purposes, that is, which tends to hinder growth or to reduce the heat or the working power of the body, cannot, of course, be called a food.

Definition of a Food.—All the above may be briefly stated in the following definition of a food: A food is any substance whose nature it is to build up the body and to repair its waste, or to supply it with energy for warmth and for work, without doing it injury.

Foods from the Mineral Kingdom.—The two principal articles that we use from the mineral kingdom are water and salt.

Salt.—Salt is found in every tissue of the body except the enamel of the teeth. As it is so generally distributed throughout the body, we must take it with our food, or we suffer greatly. Salt is naturally present in nearly all the foods we use, but only in quantities so small that there is not enough furnished in this way to meet the demands of the system; therefore we add it to our food.

Its Uses.—Salt supplies a demand of the body, and gives flavor to the food, thus making it more pleasant to us; it also causes the digestive juices to flow more freely.

It is Necessary.—Experiments have been made on animals to find out the effect of depriving them of salt. It was found that their hides became rough, their eyes grew dull, they were less active, and at last they lost their health and strength.

A Natural Demand for It.—The farmer knows how quickly his sheep will come at his call if they have learned that by so doing they can get some of this necessary food. Cattle will eat the coarsest kind of fodder if salt has been sprinkled over it. This shows the natural demand of the body for this mineral substance. In some parts of the world salt is very valuable. Fifty years ago it was expensive even in our own country. Sometimes it would take a whole load of wheat to purchase a single barrel of it. At the present time it is very cheap and plen-

tiful. In some places a dollar or two will now buy all the coarse salt that a horse can draw away.

Water.—Nearly three-fourths of the weight of the body is composed of water. If a person weighs 120 pounds, it is estimated that 85 pounds will be water. This fact alone is sufficient to show how important it is that we should drink plenty of pure water. The craving for water is greater than for food, and those who have been deprived of it describe their sufferings as terrible. A person will die sooner if deprived of water than if deprived of food.

Large Quantities Taken.—We little suspect how much water we take into the body each day. Every kind of food we use contains it. When we eat beef we take over one half its weight in water. Potatoes, that look so dry and mealy, are three fourths water; even dry sugar contains a large amount of it, while milk consists of nearly nine-tenths water. So if we do not purposely drink water, we still use a great deal of it. A healthy man takes with his food and as drink about two quarts of water each day, and it is necessary that it be taken in these large quantities; without it the blood and other fluids could not properly perform their work, and even the muscles and tendons would suffer.

Other Substances with Water.—The water we use for drinking always contains some mineral matter, some gases, and occasionally some vegetable matter.

When the mineral matter, chiefly lime, is not in excess, it is useful to the system. As lime is so important in the formation of the teeth and the bones, water that has a small amount of lime in it must be regarded as healthful, especially when the tissues are growing during early life. When water is carried through lead pipes it may dissolve enough of the lead to act as a poison when taken into the body, and so we should never drink water that has stood in lead pipes. If such pipes are used, the water should be allowed to run through them until all that has been standing in them has been drawn off.

A Cause of Sickness.—Impure drinking-water is the cause of much sickness, and thousands of deaths occur each year as a result of its use. The fact that water looks clear and has no odor is not positive proof that it is pure, for it may even then contain bacteria that will cause serious disease. Filth is the cause of many diseases, and of typhoid fever in particular. If we wish to escape this disease, we must be sure that our drinking-water is free from filth of every kind.

Where is the Well?—There is a very general idea that in order to get good drinking-water, it is only necessary to dig a hole anywhere in the ground. This is a great mistake. The well should never be in the house, nor near the barn, nor should it ever be near any place where there is any filthy matter. We must not forget that the causes of disease may be

carried through the soil for a considerable distance, and in this manner reach a well that is many feet away, especially if the soil is sandy, or slopes toward that well. A well should be at least fifty feet from any filthy place, and if possible, above the house, barn and any out-buildings.

To Purify Water.—In cities, where good water is not easily obtained, it is a wise plan to boil the water before drinking it. This is especially true when the water supply is taken from a river; then the water should always be boiled. After boiling, it can be set aside to cool. Ice should not be put into it, but around it.

Too Much Water Injurious.—It is not wise to drink too much water with our meals, as it weakens the digestive juices, and is a frequent cause of stomach troubles. It is certainly a very bad practice to chill the stomach by putting ice-cold water into it.

Foods from the Animal Kingdom.—The animal foods serve largely to build up and to repair the body. They do this because of certain elements in them which are called proteids. At the head of the list of foods from the animal kingdom we should place eggs. This is because they are easily digested, when properly cooked, and are also very nourishing. When soft boiled in the shell, or when dropped into boiling water and lightly cooked, they make a food which is usually acceptable to all. Hard boiled eggs, however, are not easily digested.

Beef is undoubtedly the best meat for general use. Tender beef, properly cooked, is easily digested, and agrees with most persons. Mutton is nearly as good as beef; but there are persons with whom it does not agree. Veal is neither so digestible nor so nourishing as mutton and beef. Lamb is more easily digested than veal, but not so nourishing as mutton. Pork is very difficult to digest. It is eaten by a great many persons, and to those who have strong digestive powers it appears to do no harm, but it should never be eaten by those whose stomachs are weak. Lobsters and crabs are exceedingly difficult to digest, and should be avoided by invalids.

Foods from the Vegetable Kingdom.—The principal grains used as foods are wheat, corn, oats, and rice, all of which contain a large quantity of starch. These foods are very important to mankind, millions of human beings eating scarcely anything else.

While starch is the principal substance in these grains, yet mineral matter, oil, and fat are present also. Wheat stands at the head as the most useful of the grains; in addition to the starch, etc., it contains a considerable amount of proteid (which we have found is in meats), and so wheat is a very important food. Oatmeal contains starch and a good supply of mineral matter; it is a wholesome food, easily digested when sufficiently cooked, and to most persons agreeable.

Among vegetables the potato is the most gener-

ally used; it is composed almost entirely of starch and water. Peas and beans are very nourishing (they

Young Farmers Weeding Their Cabbages in a School Garden

are rich in proteid), but are hard to digest, and should not be eaten freely by one who does not do out-door work. Hence, they are suitable for the farmer, but

not for the student. Turnips, cabbages, parsnips and onions are common vegetable foods that serve to give us a suitable variety. They are not very nutritious, nor are they easily digested; yet they supply a certain need of the body, for the health soon suffers if fresh vegetables are entirely left out of the diet.

Apples, peaches, and various other fruits are useful to us in many ways. The acids they contain increase the appetite and, in this way, aid the digestion, while the water they contain serves to quench the thirst; but they are not very nourishing. If uncooked, they are most wholesome for us when eaten before meals and in the early part of the day; but if cooked, they can be eaten with any meal. Dried fruits and nuts should be eaten sparingly and as a part of the meal. Nuts while very nourishing are hard to digest. They must be chewed fine. Many people who do not eat meat use nuts in its place.

Sugar.—Sugar forms an important article of our diet, and a proper amount of it should be eaten. It is found in large or small quantities in nearly all our food; and when added to certain articles of food, it makes them more pleasant to the taste. When eaten in too large quantities it is likely to cause trouble with the stomach, and with the liver, and thus to injure the health. If we desire to satisfy our natural appetite for sweet things, it is better to use simple, home-made candies than to buy cheap and highly colored candies from the stores.

Milk.—Milk must be regarded as a perfect food. It contains in a digestible form all the elements most necessary for the support of the body. Many forms of stomach disease are cured by a diet of milk alone, and it is given by physicians in fevers and other diseases. Great care should be taken to keep milk sweet and pure, as it will readily absorb gases,—a fact easily proved by placing a bunch of onions near a pan of milk in a closed box. The milk will soon be tainted by the gas from the onions, and will show it in taste and odor. Milk should be kept closely covered, and should be placed in a clean ice box, or in a room where the air is always pure and sweet.

If the value of milk as a food were better understood it would be much more largely used. For adults it may be used as a drink with the ordinary meals. During the cold weather of winter it may be taken warm. Even during the heat of summer it should not be taken into the stomach ice cold. Large quantities of iced milk are certainly injurious, especially when taken with meals.

Cream and Butter.—Butter is a most important article of diet. It is valuable because it supplies the body with needed fatty material, and also because it gives flavor to other foods, thus making them the more readily eaten and digested. It is composed principally of the fat of milk. Under the microscope milk is found to consist of a large number of minute oil-drops floating in water. We know

that oil is lighter than water, and that when the two are shaken together and allowed to stand, the oil will rise to the top. So when milk is allowed to stand, the oil will rise to the surface. This oil is called cream. Churning cream is simply beating these minute oil-drops of milk into one solid mass.

Buttermilk, Skim Milk, Cheese.—Buttermilk is a wholesome, cooling drink. Skim milk contains a small amount of fat and some of the mineral matter found in milk. Cheese is used principally as a relish and is difficult of digestion.

Fuel Foods.—We have learned that some foods, like eggs, meat, and wheat, contain proteids and serve to build up the body and to repair its daily waste. There are other foods which are rich in starch, sugar, or fat, that are called fuel foods. They keep the body warm and supply the energy with which it does its work, but they do not help to build up the body; that is the work of the proteids, and to some extent the proteids may also be used as fuel.

CHAPTER IX

COOKING

Raw Meats.—Raw meat is eaten by a large number of people. It is said that persons soon become fond of it, but it is not so easily digested as cooked meat, even when smoked or dried.

Cooking is Necessary.—We are told that it is impossible to find a race of men so uncivilized that they do not cook a part of their food. We are educated to believe that it is absolutely necessary to cook some kinds of food. Cooking is important because it brings out flavors that are agreeable, and thus pleases the taste and increases the appetite. It also either softens the article, or aids in dividing it into small particles, and thus promotes digestion. Improper cooking, however, can make the purest and best articles of food indigestible and harmful even to the healthiest stomach.

Broiling.—A tender piece of beefsteak, carefully broiled, contains a great deal of nourishment, and is easily digested. Broiling is the best way to cook meats; next to this, roasting, and then boiling.

Boiling.—In cooking meats we should remember that the natural juices ought to be retained in them

as much as is possible. This can be done by making the meat very hot at first, in order that it may be hardened on the outside, thus forming a crust through which the juices cannot escape. Therefore all meats that are to be boiled should be put into

First Lessons in the Art of Cooking

water that is boiling, and roasts should be placed in an oven that is very hot.

Frying.—Frying makes meat hard, and difficult to digest. If frying is to be done at all, the fat should be boiling hot before the food is put into it. Then an outer crust is formed at once on the outside of the food, and the oil does not pass into it so freely.

Making Soups.—When it is desired to make soups or beef-tea, the juices of the meat and not its fiber are required, hence the meat should be cut in small pieces and placed in cold water, and the water allowed gradually to come to the boiling point. Mutton broth prepared in this way is very nutritious and easily digested.

Eggs.—Eggs are cooked in many ways. For the most delicate stomach there can be nothing better than a fresh egg broken into boiling water and cooked just enough to set the albumen, or white. A soft-boiled egg is also very nourishing and easily digested. Hard-boiled eggs should be eaten only by those who have strong powers of digestion.

Vegetables.—Vegetables should be thoroughly cooked. As a rule, they are not cooked enough. The practice of frying them does not give a wholesome food. Some vegetables, as lettuce and radishes, are eaten without cooking. If taken in moderate quantity, they serve as a relish, to please the taste.

The Starchy Foods.—The various starchy foods, such as rice, and oatmeal, should be boiled a long time; without long cooking they cannot be properly acted upon by the digestive juices.

New Bread.—Newly baked bread is difficult to digest, because it is likely to form a soft, pasty mass in the mouth, and when it reaches the stomach it is a solid lump into which the digestive

juices cannot easily enter. Light, sweet bread is always acceptable to the taste, and is highly nutritious.

Pies and Cakes.—Pies and rich cakes are not wholesome foods for delicate stomachs, and should be eaten only in moderate quantities by any one. The pie crust contains too much fat, lard or butter, and the cakes have too much sugar and butter in them to make proper foods. They should never be taken in large quantities.

What Food Shall we Eat?—No rule can be given either for the kind or the quantity of food we should eat. We must learn what foods are wholesome, and how they can be spoiled by improper cooking; then each one must decide for himself what he will eat. It can be given as a rule that a proper amount of meat, together with cereals, vegetables, and fruits, is the best form of diet for most people.

Plenty of Food for Children.—Children should have plenty of good food. They take much exercise, and their bodies are growing rapidly. For these reasons Nature gives them a hearty appetite, and she expects it to be satisfied with a good supply of wholesome food.

General Suggestions.—Do your share toward preventing any waste of food. Do not have more food served to you than you are quite sure you can eat. If you aid in clearing off the table, save all the food you possibly can. To waste food is not only expensive, but it is wrong as well.

There are other things connected with the table and table manners which may seem trivial to you, and yet, when taken together, they mean much. We will mention a few; you can add others. Go to the table with clean face and hands, with the clothes neatly brushed, and with the hair in proper order. Eat slowly, keep the lips closed while chewing the food; do not drink when food is in the mouth; do not make a noise when eating soup; be cheerful and pleasant to all.

If you have a part in preparing the food for the table, we need hardly tell you that your dress should be neat and tidy, and your hands absolutely clean.

Is Alcohol a Food?—We have seen that the purpose of food is to furnish material for the growth of the body, or the repair of its waste, and to enable it to keep up its warmth and working power without injuring it. A substance whose nature it is to work contrary to these purposes has no place in the list of foods suitable for the normal body.

We have also seen that food is oxidized or burned in the body. The question has arisen in recent years as to whether alcohol should be called a food, because it can be oxidized in the body, in small quantities. The test, of course, is whether it can serve the purposes for which we take food. Tried by each of these purposes we find that alcohol contains nothing that the body can use for growth or repair, and that

with it the body is less able to work and keep warm than without it. We find also that there are other poisonous materials which the body gets rid of by oxidizing them. The fact that alcohol is oxidized in the body does not class it as a food in the ordinary sense.

Some kinds of alcoholic drinks tend to make the body gain fat; but to gain fat does not always mean that the person is gaining in health or strength, or that he is properly nourished.

When the tissues beneath the skin become filled with fat, they are made larger, therefore they push the skin outward. This removes any wrinkles in the skin, making the face look plump and round. If this change were only in the skin, or in the parts just beneath the skin, probably no great damage would take place. But many of the most important organs in the body undergo a similar change. An extra amount of fat is formed in the muscles, causing them to become soft and flabby. Even the heart may be affected in this way, causing what the doctors call a "fatty heart." Hence the fact that beer or other alcoholic drink sometimes makes the drinker fat is no evidence that it is a food.

Moreover, as we have seen, it is the nature of a true food to nourish the body without injuring it; but it is the nature of alcohol to injure the body, hence alcohol is not a food.

CHAPTER X

DIGESTION

We eat and drink because we hunger and thirst, and if our bodies are in a healthy condition, hunger and thirst may be taken as safe guides as to the amount of food and drink we need.

Thirst.—Our throats seem to tell us when we are thirsty; but thirst is a call of the whole system for liquids, and is not confined to any one part.

Hunger.—The sensation of hunger is generally said to be in the stomach; but it is not confined to any one place; it is a call of the whole system for food.

Why is Food Necessary?—Our bodies are constantly wearing out, and for this reason alone we should perish if we did not renew them with fresh supplies of food. Then, too, in growing persons new material must be supplied for still another purpose,—to make new tissues, so that the body may properly increase in size.

A healthy body must not only have new material, but must also get rid of the old, worn-out material. If our bodies should fail to do this, death would speedily follow. The skin, lungs, kidneys, and other

organs, carry off this poisonous, worn-out material, and thus the body is kept in a healthy condition.

Digestion.—Digestion is a process taking place in the stomach and intestines, by which food is prepared to be absorbed into the blood, and to supply the needs of the body. The food we take must be dissolved and changed before it can be absorbed, or taken up, by the blood vessels and carried in them to all parts of the body.

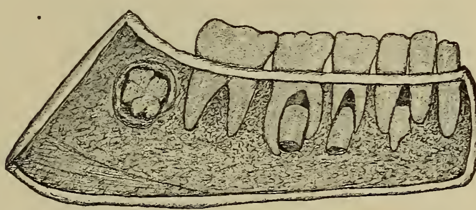


Fig. 19.—This figure shows some of the permanent teeth forming below the first or milk teeth.

We may speak of the stomach as the first organ of digestion, but we must not forget that some important preparatory work is done in the mouth, before the food reaches the stomach. Two things happen in the mouth—the food is broken up, and it is mixed with saliva.

Mastication.—The first act of digestion may therefore be called mastication, or chewing. As soon as Nature thinks we are old enough to take solid food, she furnishes us with teeth to chew it. The first teeth, called "milk teeth," appear about the sixth or seventh month, and continue to appear, one after another, for about three years. There are twenty of them. They do not stay long. The second set, or "permanent teeth," begin to appear about the fifth

or sixth year. These come one by one until the child is twelve or thirteen years of age, when all will be present except the wisdom teeth, which usually do not appear until the twentieth or twenty-fifth year. In Fig. 19, the position of some of the second, or permanent, teeth is shown. Forming in the jaw just beneath the others these gradually rise up to take the place of the milk teeth. There are thirty-two of these permanent teeth, and if they are allowed to decay, no other teeth will come to take their places.

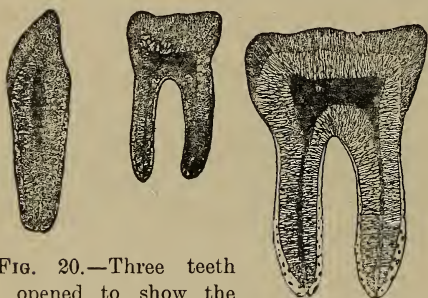


Fig. 20.—Three teeth opened to show the hollow space inside where the nerves and blood vessels are. Surrounding the top of each tooth is the enamel. The two teeth to the left are but little larger than natural; the one to the right is more highly magnified.

Importance of the Teeth.—The teeth are very necessary to digestion. They break up the food into fine particles, so that it may be thoroughly mixed with the saliva. A beautiful set of teeth adds much to the personal appearance, but a set of dirty and decayed teeth is very repulsive. We must not neglect our teeth in any way if we wish to preserve them, and escape the pains of toothache. The teeth should not be picked with a pin or with any hard substance; use instead a quill or a wood toothpick,

and run silk floss between the teeth that are set close together. Nuts should never be cracked between them. The teeth should be thoroughly cleaned at least once each day. It would be better to clean them after each meal, and at bed time. Use a small soft brush at least once each day, and should a decayed place appear, consult a dentist even if the tooth does not ache.

The Teeth Vary in Shape.—Our teeth are of various shapes, because they have different kinds of work to perform. The front ones are sharp for cutting, hence are called incisors; while the back ones are large and uneven for grinding, and are called molars.

The Inside of the Teeth.—By breaking open any tooth an opening will be found within it, as pictured in Fig. 20. In the living body this opening is filled with nerves and blood vessels, and these make the pulp of the tooth.

Decay of Teeth.—The decay of teeth is now known to be due to the action of germs. The growth of these germs is aided by the moisture and warmth of the mouth, and also by the presence of particles of food. To prevent decay, the teeth should be given careful attention and kept so clean that there may not be an opportunity for these germs to perform their injurious work. The popular belief that eating too freely of candy is likely to cause the teeth to decay is based upon the fact that sugar is favorable to the growth of many kinds of

germs; hence it is especially unwise to eat candy just before retiring and thus allow the sweet to remain in the mouth for some time.

Tooth Ache.—When a tooth aches it is nearly always because some part of it is decayed. A dentist should be very promptly consulted in order that even the smallest cavity may be filled and further progress of the decay prevented. The best preventive of toothache is to keep the teeth perfectly clean.

A Sweet Breath.—Decayed teeth always give a bad odor to the breath. For this reason, if for no other, the use of the tooth brush should be frequent. Even when the teeth are not decayed, but are merely allowed to go without proper cleaning, the breath is tainted. Bad breath may also be caused by a disordered stomach, or by some disturbance of the general health; in case it continues to be offensive, a physician should be consulted.

The Saliva.—There is a constant flow of a liquid into the mouth. It is called the saliva. When food is taken into the mouth, the flow is greatly increased. The saliva comes from glands near the tongue, and also from two large glands, one just in front of each ear. Sometimes these glands become inflamed and swollen, giving rise to a disease known as the "mumps."

Promiscuous Spitting.—Spitting in public places is not only an exhibition of bad manners, but it may

prove very dangerous to many people. The secretions thus deposited easily become dried and crushed to a powder, which floats readily in the dust of the atmosphere. This powder may contain the germs of diphtheria, pneumonia, or consumption, and if inhaled by one in good health may be the cause of producing one of these diseases. Spitting in public places is now forbidden by law in nearly all of the larger cities, and offenders are liable either to fine or to imprisonment, or, in certain cases, to both.

The Mouth and the Voice.—All the parts about the mouth, as the tongue, the teeth, the palate, should be in a healthy and normal condition; otherwise we cannot speak correctly or read aloud well. Those who speak in public need to take special care in this direction. The peculiar and undesirable nasal tone which some persons have may be due merely to carelessness or to unfortunate imitation of others. Often, however, it is caused by an unnatural condition of the mouth, nose, or throat—some trouble that a physician might correct by proper treatment. Sometimes the lower surface of the end of the tongue is attached too closely to the tissues beneath. We say that such persons are "tongue-tied"; they cannot protrude the end of the tongue well from the mouth, and often have difficulty in pronouncing the letter "*s*" distinctly. Enlarged tonsils will also interfere with speech. Many of these imperfections are easily corrected.

CHAPTER XI

DIGESTION IN THE STOMACH

The Stomach.—By the act of swallowing, the food passes from the mouth down a tube in the throat called the "œsophagus," into the stomach. The stomach of an adult is nearly a foot in length, and three or four inches in diameter. It has a firm outer wall of involuntary muscle, while the inside consists of a delicate membrane called the mucous membrane which is arranged in folds, or wrinkles. When the stomach is well filled, these folds spread out and disappear.

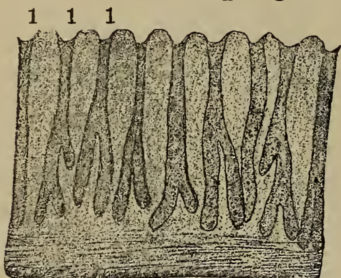


Fig. 21.—A cross section of a small portion of the walls of the stomach, slightly magnified, showing how the glands open into it, as at 1.

Glands of the Stomach.—In the mucous membrane are glands so very minute that they cannot be seen without a microscope. Fig. 21 shows how a cross section of this membrane looks when examined with a magnifying glass. The inside of the stomach is at the top of the figure, and the outer wall of muscle

is at the bottom. Nine of these glands are seen in Fig. 21, all opening on the inside of the stomach. A careful examination of these glands, with the aid of the microscope, shows, Fig. 22, that they are composed of cells of different shapes and sizes. Certain cells secrete, or manufacture, a particular part of the digestive juice, while others do other work.

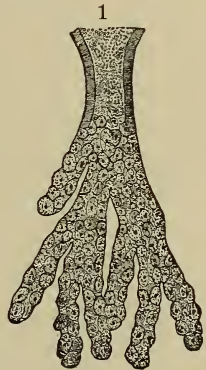


Fig. 22.—One of the glands of the stomach, as seen with a microscope. It opens into the stomach at 1.

The Gastric Juice.—The round bodies, or cells, seen in these glands make a juice, called the gastric juice. Just as soon as food reaches the stomach these cells begin to pour out this juice, which is to change much of the food. At the same time the walls of the stomach begin to move, contracting and relaxing, and thus mixing the food thoroughly with the juice. The grayish fluid thus formed from the food is called chyme.

The gastric juice changes certain of our foods so that they can be taken up by tiny blood vessels and, in due time, carried to all parts of the body. Not all the foods we take are digested in the stomach by this juice; some of them pass out of the stomach unchanged, and are digested in the intestines. The oily or fatty foods, and all the starchy foods that are not changed in the mouth by the

action of the saliva, are digested in the intestine; such foods as lean meats and eggs (proteids) are chiefly digested in the stomach. The fact that solid meats and some other foods can be digested in the stomach is largely due to the presence of two substances in the gastric juice, pepsin and an acid.

The Time Required for Digestion.—A few hours after food has been taken, the stomach is again empty. The time required for the stomach to complete its work depends upon the kind and the amount of food, the liquids that are taken during the meal, the health of the person, and other conditions.

The following table shows the time required for the digestion of different foods:

Easy of Digestion	h. m.	More Difficult	h. m.
Rice, boiled	1.00	Potatoes, boiled	3.30
Apples, sweet, raw	1.30	Oysters, fried	3.30
Milk	2.00	Eggs, hard boiled	3.30
Cabbage, raw	2.00	Pork, broiled	3.30
Oysters, raw	2.30	Veal, roasted	3.30
Potatoes, baked	2.30	Veal, fried	4.00
Chicken, boiled	2.45	Beef, fried	4.00
Eggs, soft boiled	3.00	Cheese	4.00
Custard, baked	3.00	Cabbage, boiled	4.30
Beef, broiled	3.00	Duck, wild, roasted	4.30
Beef, roasted	3.00	Pork, fried	4.30
Mutton, roasted	3.15	Pork, roasted	5.15

Eat Slowly.—One of the most frequent causes of trouble with the stomach is too rapid eating. The solid foods should be thoroughly chewed, and all food well mixed with the saliva, because the saliva

has the power of changing the starch of our food into a kind of sugar. As all starch must be thus changed before it can be taken up by the blood-vessels, it follows that the action of this fluid is important. The food is in the mouth so short a time that only a part of the starch is changed into sugar there, the rest being changed at a later period, when it passes into the intestines. Still, it is important that the saliva should be given a chance to do its part in bringing about this change.

The gastric juice will not dissolve, or digest, the solid foods in the proper time if the pieces are too large when swallowed. We should eat slowly, not only because it is good manners, but also because the saliva is thus mixed with the food, and further because there is then time for the gastric juice to be formed, and to be thoroughly mixed with the food as that is swallowed.

Liquids at Meal-time.—If we made a habit of drinking too freely of iced water, or cold water, during a meal, digestion would be interfered with, and some form of stomach trouble would be likely to follow.

CHAPTER XII

DIGESTION IN THE INTESTINE

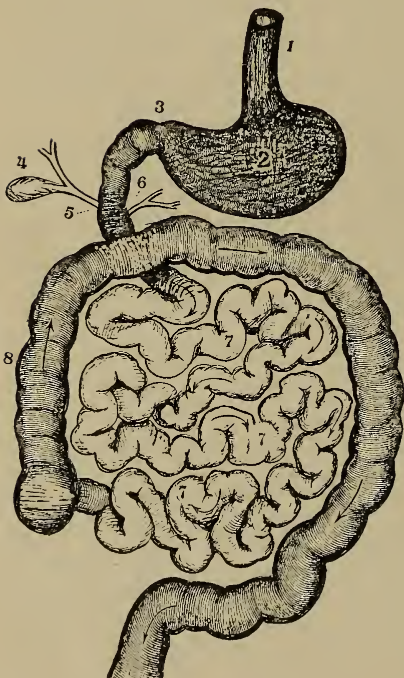


FIG. 23.—(1) The œsophagus; (2) the stomach; (3) the lower opening of the stomach; (4) the gall bladder; (5) the duct carrying bile to the intestine; (6) the duct from the pancreas; (7) the small intestine; (8) the large intestine.

The process of digestion is not completed in the stomach. After the stomach has done its work, the lower opening, shown in Fig. 23 at (3), relaxes, and that part of the food, or chyme, that has not been fully digested passes into the small intestine to undergo a final change.

Within a few inches of the stomach there are poured into the intestine the juices formed by the liver and pancreas. These juices change the chyme into a

milky fluid called chyle. Fig. 23 shows the situation of the ducts that convey these juices.

The Liver.—The liver is a large organ lying principally in the right side of the body, just under the lower ribs, as in Fig. 24. In the adult this organ weighs between three and four pounds.

The Bile.—The fluid secreted by the liver is called bile. The liver is constantly forming bile, although there are times when an increased quantity of it is poured into the intestine. The bile may pass directly from the liver into the intestine, or it may first pass into the gall-bladder, and from there into the intestine, the gall-bladder acting simply as a reservoir for the bile. The duct from the liver unites with the duct that comes from the pancreas, and both terminate as one duct, which opens into the intestine.

About two and one half pints of bile are secreted each day. If the liver fails altogether to secrete this substance, sickness and death follow. If enough is not secreted, then the whole body is affected, and sickness follows. When the passage from the liver to the intestine is stopped up in any way, then the bile is taken up by the blood vessels, and carried to all parts of the body, making the skin yellow. The person thus affected becomes very ill, and we say that he has jaundice.

The Liver Sugar.—We remember that all starchy foods are changed into a kind of sugar before they

are absorbed; therefore all the starchy foods and all the sugar we eat are absorbed into the body as so much sugar. This sugar is carried directly to the liver. The liver makes certain changes in the sugar which it stores up in its cells until some time between meals, when it gives the sugar out again to the body. Thus the liver acts as a great storehouse; takes some of the digested food when there is plenty of it, and stores it up until such time as the body needs it, and then gives it out as so much sugar.

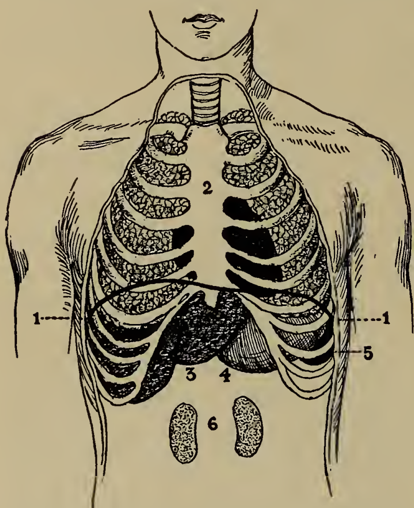


Fig. 24 shows the location of the principal organs of the trunk: (1) the diaphragm, the irregular curved muscle which divides the trunk into two large cavities,—the thoracic cavity above, and the abdominal cavity, below; (2) the breast-bone, on each side of which are the ribs; (3) the liver, beneath the diaphragm in the *right* side of the body (left side of Figure); (4) the stomach; (5) the spleen; (6) the kidneys.

The Pancreas.—Behind the lower part of the stomach is the pancreas. This is a slender organ, about six inches in length, which secretes a juice called the pancreatic juice. The duct that carries this juice to the intestine unites, as already

stated, with the one from the liver before entering the intestine. Behind the stomach, on the left side of the body, is the spleen.

The pancreatic juice is very important in digestion, as it changes the starchy foods into sugar, and thus completes the work begun by the saliva. This juice will also digest all foods that the gastric juice can digest. It is the only juice that digests fats.

Glands of the Intestine.—There are glands in the walls of the small intestine that secrete a juice which aids in the digestion of foods, especially the starches and fats.

How many Fluids?—We have learned that there are five fluids used in digesting the food. First, the saliva; second the gastric juice; third, the bile; fourth the pancreatic juice; and fifth, the intestinal juice. Twenty pounds of these juices are probably secreted every twenty-four hours.

To Assist Digestion.—Eat slowly. Eat at regular hours. Eat mild fruit before meals. Chew the food thoroughly. Be cheerful at the table. Do not eat between meals. Do not eat just before going to bed. Do not wash down food with too much drink.

The Large Intestine.—The parts of the food that are not digestible, and those that have not been digested, pass from the small into the large intestine. These waste materials should be regularly expelled from the large intestine at least once every day.

CHAPTER XIII

ALCOHOL, TOBACCO, OPIUM, AND THE DIGESTIVE ORGANS

Pure alcohol is not ordinarily taken into the stomach; it would have the most serious effects at once, if taken undiluted. Alcohol is generally used in the form of wine, whiskey, beer, or other liquors, and it is the effects of these that should be understood. The strongest liquors, such as brandy, consist of one half alcohol, while the weaker liquors, such as beer, contain about one tablespoonful of alcohol to a large tumblerful.

The first effect of alcoholic beverages on the mucous membrane of the stomach is to cause an increased flow of blood to it. A most important result follows this. The glands of the stomach secrete an extra amount of gastric juice. This is so important an effect that if we were to stop our investigation here, we should be justified in believing these liquors to be of benefit, causing a more abundant flow of the gastric juice. But on further investigation we find that the stomach needs more time to digest food, when alcoholic liquors are taken with it, than when only water is drunk. This

has been the result of many experiments, and no experiments on the other hand have shown that alcoholic drinks can be depended upon to hasten or to aid digestion.

The continued use of alcoholic drinks is liable to give rise to dyspepsia, or other forms of stomach trouble. Indeed, it may cause a disease known as gastric catarrh, which is an inflammation of the stomach. This inflammation makes heat, and this heat gives rise to a thirst and to a peculiar faint or sickening feeling, to quench which more liquor is used. For a short time this deadens the feeling, and the man thinks his drink has helped him. But as the stomach gets more inflamed it demands more liquor, and the frequency and quantity are increased, until an appetite is formed. Now the body is constantly craving more fluid to quiet the disturbed stomach and other organs. The man who thus uses alcoholic drinks is a sick man, and should be under the care of a physician, that his diseased body may be restored to health.

The changes and effects we have described may come from the continued use of alcohol in amounts that are considered quite moderate. When large doses are taken within a comparatively short time, several results may follow. A very common result is acute inflammation of the stomach. The effects of this acute attack may disappear after a few days, provided no more alcohol be taken.

The prolonged use of alcoholic liquors is liable to cause changes in the structure of the stomach. The blood vessels may become permanently enlarged, the glands reduced in size, and the gastric juice weakened and unable to do its work. As a result, there is constant and distressing pain in the stomach, and loss of strength. This condition of things may go still further, until the stomach will not retain any food given it, and a painful and fatal illness results.

When we know that one glass of liquor may create a desire for another, and when we understand to what all this may lead, we are certainly prepared to agree that the best way to deal with such a drug is to let it alone.

The Effect on the Liver.—It is probable that some of the alcohol taken into the stomach is there absorbed, the rest passes out and is absorbed from the intestines. When it is taken up by the blood vessels of the stomach, the first organ to which it is carried is the liver. Here it is capable of doing much damage. The liver, like all other organs, is made up of cells. These cells should have but very little, if any, fat in them. If they are clogged with fat, they can no longer either secrete bile, or store up sugar for use in the body. But alcoholic drinks often cause the liver, first, to become large and fat, and afterward, smaller and harder than in health. This small hard liver is so

characteristic that it has been given a distinct name by medical men, "the drunkard's liver." Such a change in the structure of the liver must, sooner or later, bring about a general disorder of the whole system. The liver may be made to suffer in other ways, as well; but these two results are sufficient to show the ill effects of this drug,—first, an enlargement and fatty change, and second, after prolonged use, a shrinking and hardening of its structure.

Effects of Tobacco on Digestion.—The effects of tobacco on digestion are largely of a secondary nature. It first affects the digestion of those who chew, because the salivary glands are so continuously over-worked that when the saliva is most needed, at meal time, only a scanty amount is furnished. Its more severe effects are shown through the nervous system, causing a particular kind of indigestion, called nervous dyspepsia.

No Use for Tobacco.—While the evil effects of tobacco do not show alike in all its users, yet it is certainly true that in very many cases its habitual use does serious harm. To the growing boy, or the rapidly developing young man, tobacco is plainly injurious. The younger the person who uses it, the more harmful it is. With many young men it appears to dull their interest in others, and leads to selfishness. We see young men about us, puffing away at their cigars or cigarettes, indifferent or thoughtless as to the comfort of those about them

who do not like tobacco. No one who is possessed of the real spirit of kindness, which is the distinguishing mark of a gentleman, will gratify his own desires at the cost of the comfort of others. Everybody has a right to breathe pure air. The smoker who fills the air that others must breathe with the fumes of tobacco, is trespassing upon the rights of others.

Opium.—This drug will completely stop digestion. It takes away the appetite, checks the flow of the gastric juice, and seriously affects the whole digestive apparatus.

Tea and Coffee.—When taken very strong and in large quantities, these beverages are quite sure to interfere with digestion.

CHAPTER XIV

ABSORPTION

Preparation of Food for Absorption.—In the previous chapters we have traced the principal processes of digestion. We have learned that the saliva changes some of the starchy foods into sugar; that the gastric juice digests lean meats, eggs, etc. We have found that the pancreatic juice digests the fats, changes the undigested starches into sugar, and finishes the work of the stomach; and that the bile flows into the intestine to give its aid.

This work is done in order that the foods may be changed to a form in which they can be absorbed. Absorption takes place principally in the small intestine, although there is absorption from the stomach, and to a lesser extent from the large intestine. The latter is, however, principally a temporary storehouse for the waste materials of digestion, soon to be removed from the body.

Absorption from the Stomach.—The water that is taken into the system is not absorbed from the stomach, but passes, after a short time, into the intestines. In the stomach there is some absorption of sugars and of the changed proteids in the food.

Absorption from the Small Intestine.—Hanging down

from the inner walls of the small intestine are minute projections, like fingers; these are called villi. There are several millions of them in the body.

Fig. 25, B, shows a cross section of the small intestine, with a number of these little fingers, or villi, hanging into the central cavity. It also shows the two kinds of vessels. Let us place one of these villi

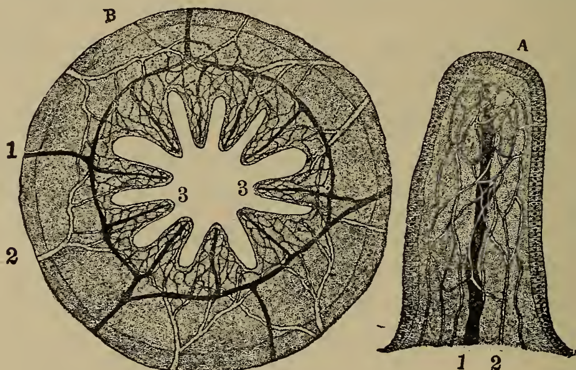


Fig. 25.—(B) a cross section of the small intestine. (A) one of the villi of B, highly magnified; (1) the lacteals, or lymphatics; (2) the blood vessels; (3) the villi.

under the microscope. We now see that a layer of cells covers its outside, while within, it consists almost entirely of the two kinds of vessels. Directly in the center is the lacteal, or lymph vessel. There is also a large number of minute blood vessels. What are these villi for? What is the single lacteal for? Of what use are so many little blood vessels? As the fine rootlets of a plant soak up nourishment from the ground, so these villi take up digested food.

The digested food soaks through the thin walls of the villi as water soaks through a cloth. Once in these little vessels, the absorbed food flows into larger vessels, and these soon unite together in one or two still larger vessels.

The work of the lacteals, in the villi, is largely to take up the digested fats, while the blood vessels take up principally the other digested foods.

The Portal Vein.—The blood vessels of the villi soon unite with each other and with those of the stomach to make a large vein, called the portal vein. Its duty is to carry the digested foods to the liver. From this organ they will be conveyed by a large vein to the heart. Thus the blood, with its digested foods, reaches the right side of the heart, and from the heart goes to all parts of the body.

The Thoracic Duct.—The lacteals, or lymphatics, that are in the center of the villi soon unite to make a large vessel, called the thoracic duct. This duct is as large as an ordinary slate pencil, and it runs up in front of the spinal column, emptying into the large vein just beneath the left collar bone, and this vein also goes directly to the right side of the heart.

The Lymph Corpuscles.—If some of the liquid in the thoracic duct be examined with the microscope, there will be found a vast number of minute bodies called lymph corpuscles. When these get into the blood they are called white blood corpuscles, and we shall learn more about them later.

How the Digested Foods Enter the Circulation.— Let us follow, for example, the course of broiled steak. First, the steak is thoroughly chewed, or masticated; second, it is swallowed; third, it is digested by the gastric juice; fourth, it is forced into the intestine by the contraction of the stomach, and acted on there by the pancreatic juice; fifth, it is absorbed from the intestine, principally by the blood vessels of the villi; sixth, it is carried by these vessels into the portal vein; seventh, it is carried by the portal vein into the liver; eighth, it passes out of the liver through large veins to the heart.

Starchy foods are changed into sugar by the saliva and the pancreatic juices; they reach the liver through the same channels as the digested meat.

Fatty foods are first masticated, if necessary; second, they are swallowed; third, they pass out of the stomach unchanged; fourth, in the intestine they are mixed with the bile and the pancreatic juices, and so changed that they can be absorbed; fifth, they are absorbed mainly by the lacteals; sixth, the lacteals carry them to the thoracic duct; seventh, they pass up this duct and empty into the large vein which carries them directly to the heart.

When we are thinking of the course of the digested foods, we must remember that portions of our food are not digested, but pass to that storehouse for waste, the large intestine and from there pass out of the body.

CHAPTER XV

THE BLOOD

Amount of Blood in the Body.—About one twelfth of the weight of the body is composed of blood. When the skin is cut, blood flows from the wound, though there are certain portions of the body in which we cannot find blood; namely, the hard parts of the teeth, the hair, the nails, the outer layer of the skin, some parts of the eye, and most of the cartilages. These are nourished by fluids which soak through from the blood vessels.

Composition of Blood.—Blood appears to the unaided sight like a simple, red liquid; but the microscope shows that there are two parts; first, a watery fluid, called the plasma, and second, some minute bodies, known as the blood corpuscles. The liquid plasma, which is not at all red, looks much like water, but we know there are many important substances dissolved in it which we cannot see and which can be found only by the chemist. The blood corpuscles are of two kinds, white and red, and may be seen and studied with a powerful microscope. It is the vast number of the red corpuscles in the blood that makes it look like a red fluid.

White Corpuscles.—A white corpuscle, as its name tells us, is without color. When persons become weak and pale, the microscope shows that their blood has in it too many of the white corpuscles, and not enough of the red. There ought to be only one white corpuscle to about five hundred red.

Red Corpuscles.—The red corpuscles of man are circular bodies that are slightly hollowed towards

Fig. 26.—(1) Frog's blood; (2) Human blood. (A) the white corpuscles; (B) the red corpuscles. (C) edge of corpuscle showing hollow sides.

the center. In a great many of the higher animals they are of this same shape, but in birds, fishes, snakes, and some other animals, they are oval. Fig. 26 shows the oval corpuscles of frog's blood, and the circular ones of human blood. One red corpuscle of man's blood is represented as seen on the edge, which shows how it is hollowed towards the center. These corpuscles are very small. If placed side by side in a straight line, it would take over three thousand of them to cover a single inch in length.

The Number of Red Corpuscles.—It is impossible for us to realize how many red corpuscles there are in the body; in a small drop of blood there are as many as five million.

Their Use in the Body.—The red corpuscles may be compared to little circular boats floating in the water of the blood. They go to the lungs, where they get very near the air, and take from it all the oxygen they can carry. Then they hasten away to some distant part of the body where some tissue needs oxygen. To such tissue the corpuscles give up their oxygen; then they hasten back to the lungs for another load. For this reason, the red corpuscles are called oxygen carriers.

Arterial Blood.—When these corpuscles have a great deal of oxygen in them, as they have when leaving the lungs, they are bright in color, and they make the whole blood appear bright scarlet. This bright-colored blood is found in the arteries, hence it is called arterial blood.

There is, however, one place where this bright blood is found in the veins; namely, in those that carry the blood from the lungs to the left side of the heart. They are called the pulmonary veins.

Venous Blood.—After the corpuscles have given up their oxygen to the tissues, they become a darker red, and as a result, the whole blood looks darker. Dark blood is found in the veins, with one exception, namely, in the case of the pulmonary artery that

carries blood from the right side of the heart to the lungs. We say that the arteries contain arterial blood, and the veins venous blood; but to this rule there are the two exceptions we have just given,—the pulmonary artery and the pulmonary veins.

What We Breathe.—The air we breathe consists principally of two gases,—oxygen and nitrogen. Carbon dioxide is found only in very small quantities in "pure air."

All parts of the body need oxygen. If we did not have it we should die in a few moments. It is necessary that we should have it in large quantities; for this reason we are more healthy if we always breathe fresh and pure air. Nitrogen serves only to dilute the oxygen, for we could not live in an atmosphere of pure oxygen. As the tissues take up the oxygen from the blood, they give back to it small quantities of carbon dioxide, which is removed from the body by means of the lungs.

Differences between Arterial and Venous Blood.—The principal differences between arterial and venous blood are these:

Arterial blood has more oxygen than has venous blood.

Venous blood has more carbon dioxide than has arterial blood.

Arterial blood parts with its oxygen in the capillaries, about which we shall learn in the next chapter.

Venous blood parts with its carbon dioxide in the lungs.

Arterial blood is of a bright scarlet color.

Venous blood is of a darker red color, shading toward purple.

The Clotting of Blood.—After blood is drawn from a blood vessel and has stood for a short time, it thickens into a jelly-like mass. This is called the clotting, or coagulation, of the blood. Blood does not clot while it is in the blood vessels, unless there is some disease. It is because the blood clots that we do not bleed to death when we cut through the skin, or in any way cause the blood to flow. The little clot that is formed at the opening of the blood vessel closes it and the flow ceases. If the blood flows slowly it will clot more easily. So when we are wounded in any way, we should help the blood to clot by checking its flow for a short time. This may be done by pressing on the wounded spot, and by keeping the part very quiet, so that after the clot has formed it will not be disturbed.

When One is Injured.—When one is injured we can tell whether the blood is from an artery or a vein by the way it flows. If it comes from an artery, it flows in jerks; we say the blood spurts. If it comes from a vein, the flow will be in a steady stream. It is more dangerous to injure an artery than a vein, as the flow from an artery is not so easily stopped.

CHAPTER XVI

CIRCULATION

To understand how the blood is carried to all parts of the body we must study the heart, the arteries, the capillaries, and the veins.

The Heart.—The heart is a large involuntary muscle. It is situated in the chest between the two lungs. In shape it is something like a pear, with the small end down and to the left. By reference to Fig. 24, it will be seen that the heart and lungs nearly fill the cavity of the chest, and that they are separated from the organs in the abdomen by the thin wall of muscle called the diaphragm. The heart is enclosed in a sac, the lower part of which rests on this diaphragm.

The Position of the Heart.—The heart is not all on the left side. If we draw a line down the middle of the breast-bone, the heart will extend about three inches to the left of the line, and one and a half inches to the right. The base, or larger part, is up as high as the third rib, and more of the base is on the right side than on the left. The point of the heart extends well over into the left side: it is there we can feel it beat. Figure 24 shows

that this point is between the fifth and sixth ribs, and that the heart is placed obliquely in the chest.

The Cavities in the Heart.—The heart is divided lengthwise, by a firm wall, into two parts, so that there is no connection whatever between the two sides. The left side always contains arterial blood, and the right side venous blood. By reference to Fig. 27 it will be seen that the parts 3 and 4 together represent the two divisions of the right side, while the parts 7 and 8 together represent the two divisions of the left side. The wall between the two is shown by the location of a small blood vessel seen on the outside of the heart to the left of number 8.

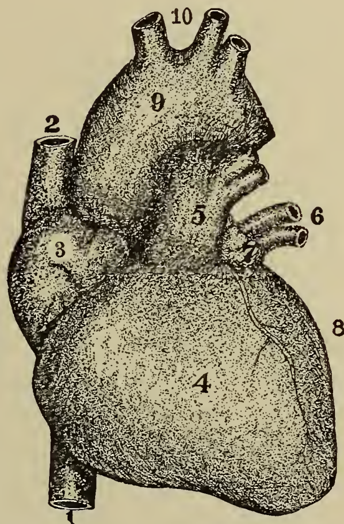


Fig. 27.—The heart, and the larger vessels at its base or upper part: (1) and (2) veins; (3) right auricle; (4) right ventricle; (5) pulmonary artery; (6) pulmonary veins; (7) left auricle; (8) left ventricle; (9) aorta with (10) small arteries branching off.

Notice in the diagram (Fig. 28) how the cross partition divides each side into two parts. This wall is not a complete one, but has openings through it, so that blood can pass from (3) to (4) on one side, and from

(7) to (8) on the other. These openings are protected by doors which Nature has provided; these doors are called valves. The firm wall lengthwise and the cross partitions divide the heart into four cavities. The two upper cavities are called the auricles. They are so named because they look somewhat like ears; the word auricle means ear. The four cavities are as follows: the right auricle, the right ventricle, the left auricle and the left ventricle. A careful study of the diagram, Fig. 28, will help to make all this clearer.

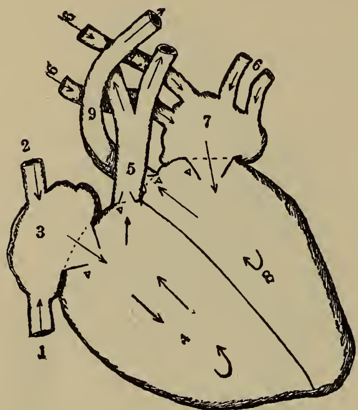


Fig. 28.—Diagram illustrating the flow of blood through the heart: (1) and (2) large veins that carry the blood back to the right auricle; (3) right auricle; (4) right ventricle; open valves between them; (5) pulmonary artery, carrying blood to the lungs: notice the open valves; (6) pulmonary veins, bringing blood from the lungs to the auricle; (7) left auricle; (8) left ventricle; notice the valves; (9) the aorta; notice the valves.

The Contraction of the Heart.—Each ventricle holds from four to six ounces of blood. When the heart contracts, it makes its cavities smaller, thus driving or pushing the blood that is in it out of those cavities, and through the large channels which lead from its upper part.

The Course of the Blood Through the Heart.—Let us follow the circulation of the blood through the heart. Notice Fig. 28, and follow the numbers in order, also the arrows. Two large veins, (1) and (2), carry the blood from the body to the right auricle. The right auricle (3) contracts and pushes the blood into the right ventricle (4). The right ventricle contracts and pushes the blood into a large vessel, called the pulmonary artery (5). This soon divides into two vessels, one going to each lung. After passing through the lungs the blood is brought by the pulmonary veins (6) to the left auricle (7). The left auricle contracts and pushes the blood into the left ventricle (8). The left ventricle contracts and pushes the blood into a large artery, the aorta (9), which carries it to other vessels, Fig. 29. Briefly, the circulation follows this course: from large veins into right auricle; then through right ventricle; then through the lungs; then to the left auricle; then through left ventricle; then out to the body.

Unequal Power of Contraction.—The right ventricle of the heart has to contract with just force enough to send the blood to the lungs, which are only a short distance away; but the left ventricle has to contract with force enough to send the blood to distant parts of the body. Hence the walls of the left ventricle are much thicker and stronger than those of the right.

The Valves in the Heart.—By reference to Fig. 28 some valves will be seen. They are represented as doors that can open but one way; hence they will not let the blood flow in the wrong direction. If the blood should try to pass back, these doors would tightly close. These valves are seen between (3) and (4), between (4) and (5), between (7) and (8), and between (8) and (9).

The General Circulation.—A study of Fig. 29 will help those who wish to learn the general location of the principal arteries. The dark lines represent the arteries, carrying the blood in the direction of the arrows, away from the heart. The lighter lines represent the veins, carrying the blood toward the heart. The carotid arteries (1) carry the blood to the head. The beat of these arteries can

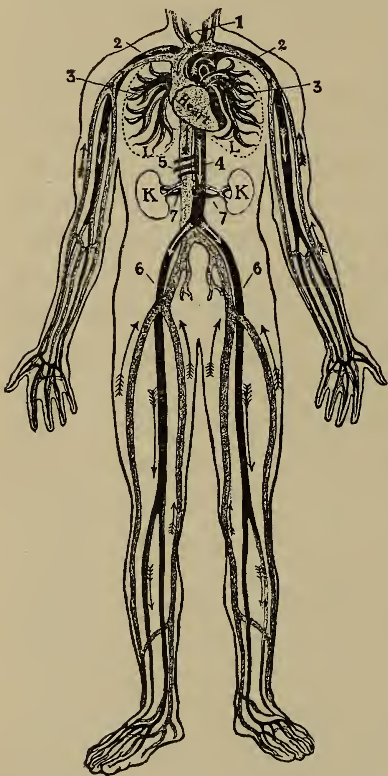


Fig. 29.—The general plan of the circulation.

be felt by placing the fingers on each side of the neck. (2) Large arteries beneath the clavicle. Each artery extends down the arm, and when it reaches the upper arm it is called the brachial. At the elbow it divides into two arteries; one is by the side of the radius, hence is called the radial artery; the other is by the side of the ulna, hence is called the ulnar artery. (3) Arteries of the lungs (L). (4) Continuation of the aorta. When this reaches the abdomen it is called the abdominal aorta. (5) Three branches from the aorta; one supplying the liver, another the spleen, and another the stomach. (6) In the abdomen the aorta divides into two large arteries, one going to each leg. When each artery reaches the thigh it is called the femoral artery because it is by the side of the femur. (7) Arteries which supply the kidneys (K).

The Heart Rests.—All the tissues of the body must have rest. The heart too has its time for rest. That comes between the contractions; each time there is a slight pause before the heart contracts again. This seems a short rest, yet when all these short periods of rest are put together they amount to between six and eight hours a day.

The Heart Works.—The heart does an immense amount of work. Suppose the heart beats seventy times each minute: this would give over four thousand beats an hour, and over one hundred thousand a day. If all the work that the heart does in a

single hour could be done at one beat, the force would equal that required to lift five tons of coal a foot from the ground.

How Fast Does the Heart Beat?—Some things will make the heart beat fast, and others will make it beat slowly. Sorrow and depression of spirits make it beat slowly. Excitement, as joy, anger, etc., makes it beat fast; exercise makes it beat fast. It beats faster when we are standing than when we are sitting; faster when sitting than when lying; faster when awake than when asleep.

The number of beats is about ten more each minute in women than it is in men; in men it is between sixty and seventy a minute. Some persons have naturally either a slow or a quick pulse. The number of beats per minute is less in old age, while in young children it is as high as 120 to 140 a minute.

The Sounds of the Heart.—Each time that the heart beats it makes two sounds. These can be distinctly heard if the ear be placed over the heart. One sound quickly follows the other, and then there is a period of silence, during which time the heart is at rest. You will notice that these sounds are not alike. They are always of a certain character in health, so that the physician is able to tell, by listening to them, whether the heart is diseased or not.

The Pulse.—The pulse at the wrist is caused by the sudden expansion of the artery there. The

heart pushes so much blood into the arteries that it makes them swell, or expand, at each beat.

Arteries, Veins, and Capillaries.—The largest artery in the body is the one that comes from the left ventricle of the heart; it is called the aorta. Fig. 29 shows that not far from the heart the aorta gives off many branches. These branches divide again and again into smaller arteries, which supply every organ and tissue with blood. The arteries, in turn, branch into tiny tubes so small that they cannot be seen with the unaided eye; a microscope is necessary to study them. These fine branches are called capillaries. Fig. 30 suggests the way in which a small artery divides to make the capillaries, and also how these capillaries unite to make a small vein. While the blood is in these capillaries the tissues take from it the oxygen which the red corpuscles carry; they also obtain nourishment for their growth and repair.

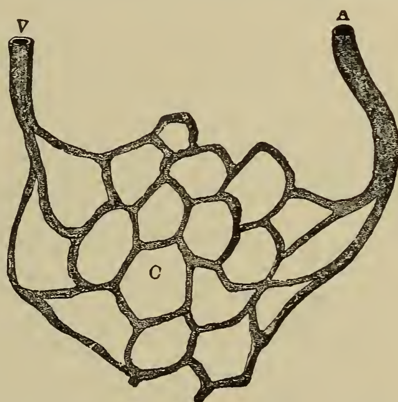


Fig. 30.—(A) a small artery; (C) capillaries; (V) a small vein.

The Lymphatics.—We have learned (see page 83), that a particular set of lacteals or lymphatics

conveys the digested fats from the intestines to the large vein beneath the left side of the collar bone. There are also other lymphatics, which consist of very small vessels and are distributed all over the body. These lymphatics collect the old worn-out materials from all parts of the body and carry them to the blood vessels, from which they are taken up by organs made especially for such work, as the kidneys and other glands.

Fig. 31.—(1) A vein, with the valves closed. The blood cannot flow in the direction of the arrow; (2) a vein, with the valves open. Nothing prevents the blood from flowing in the direction of the arrow.

Valves in the Veins.—We found that there were valves in the heart to keep the blood from flowing in the wrong direction; and we find that there are many valves in the veins for the same purpose. Fig. 31 shows the arrangement of these valves. In the vein marked 2 the valves are open, and the blood is flowing in the direction of the arrows without anything to prevent it. But if the blood should attempt to flow in the opposite direction, as shown in the vein marked 1, then

the valves would close and completely shut off the passage.

Rapidity of the Circulation.—The heart contracts with such force that the flow of blood in the large vessels near it is very rapid, but when the blood passes through the small capillaries, the rapidity of its current is greatly lessened. The current in the veins is not so rapid as in the arteries, and is the slowest in the capillaries. The heart contracts with such force and frequency that a quantity of blood can leave it, go to the most distant parts of the body, and get back again to its starting place in less than half a minute.

CHAPTER XVII

THE EFFECTS OF ALCOHOL AND TOBACCO ON THE HEART AND ON THE CIRCULATION

On the Heart.—It is frequently noticed that after a person has taken an alcoholic drink his face becomes flushed and his heart for a short time beats faster. From this the conclusion has been drawn that alcohol increases the force and frequency of the heart-beat, and for this reason it has been called a stimulant.

But recent careful experiments have shown that the quicker beating of the heart after alcohol is taken is not due to any direct action of alcohol upon the heart itself or upon any part of the circulatory system.

When a moderate amount of an alcoholic liquor is so diluted that it does not irritate the throat or stomach, and when the person taking it is kept perfectly quiet, there is seldom any quickening of the pulse.

From this fact men of science infer that what has been called the "stimulating" action of alcohol may result partly from its irritating effects upon the throat and stomach; partly also from

the inclination of the drinker to make livelier bodily movements than before, and we have already learned that muscular exercise tends to increase the action of the heart.

The continued use of alcoholic drinks is a frequent cause of a thickening of the walls of the heart and an enlargement of its cavities. Another form of heart disease often due to alcohol is known as "fatty heart." In this disease a part of the strong muscular fibers of the heart give place to fatty material which has no power to contract; hence, the heart becomes weakened and unable to do its work properly.

A weak heart does not have power enough to send the blood completely around its circuit, and this causes dropsy, difficult breathing, and other ailments. Sometimes these changes in the heart are so extensive that the heart gradually becomes weaker and weaker until it is no longer able to contract, and hence ceases to beat. There are other causes of a "fatty heart," but medical men everywhere recognize the use of alcohol as a frequent cause.

On the Arteries.—The tissues that compose the walls of the arteries also are liable to undergo fatty change from the use of alcoholic liquors. As a result, they are weakened, and thus are more liable to burst. When such a break occurs in the brain, it causes a serious or fatal attack of a disease called apoplexy.

On the Smaller Vessels.—There are nerves in the body whose only duty it is to keep the walls of the small blood vessels contracted to a certain size, so that they will be firm and not liable to become too full of blood. Alcohol so affects the nervous system that these minute nerves lose their full power. This may be only temporary, as when a single dose of alcohol is taken; or, if the dose be frequently repeated this condition may become permanent, so that entire freedom from alcohol will not restore the original power to the nerves.

What do the red nose, the red eyes, and the red face of the confirmed drunkard show? They show that the small blood vessels have become permanently distended and contain too much blood. Many who begin to feel the effects of alcohol would stop their downward course if they could. But the stomach demands more to quiet its burnings; the nerves wake from their sleep and by their aches and pains demand to be quieted again. The true physician steps in here and declares that the patient is ill and needs careful attention. He prescribes outdoor exercise, treats the inflamed stomach, allows only a limited diet until the liver recovers its normal condition and strongly advises that new friends and associates be formed, and that no alcoholic liquors be used again. If the power of self-control has not been too greatly weakened, temptation may be resisted and the weak body may slowly recover,—a

happy result, which one could wish might always follow.

Tobacco.—A deadly poison called nicotine is contained in tobacco. If pure nicotine be taken in sufficient quantity it quickly and completely paralyzes the heart. When the fumes of tobacco are inhaled, only a very small amount of this poison enters the system. Still, even this small amount, when taken steadily for a long time, is liable to cause palpitation of the heart, as well as severe pain. Under the influence of nicotine the beat of the heart becomes unsteady and irregular. This effect is so frequently seen that physicians call this form of heart trouble "the tobacco heart." Some of the most severe cases of tobacco heart result from the smoking of cigarettes.

Stimulants and Narcotics.—Alcohol has been wrongly called a stimulant, while it is really a narcotic. Let us see why. The word stimulant means something that increases activity. The name narcotic is applied to substances that decrease activity by weakening or deadening the nervous system, which, as we shall learn, governs all the activity of the body. Now the chief and lasting effect of alcohol is the weakening or deadening effect, consequently scientists class it as a narcotic. Tobacco is also a narcotic. Among the real stimulants we might name digitalis, commonly known as fox-glove, which is a powerful heart stimulant. Strychnine and nitroglycerine are also stimulants.

CHAPTER XVIII

RESPIRATION

The Larynx.—After the air has passed through the nose it reaches the larynx. This is sometimes called the voice-box, because it contains some membranes that are used in producing sounds. The expansion on the front of the larynx is commonly known as Adam's apple.

FIG. 32.—View of the inside of the nose, mouth, etc; (1) the mouth; (2) position of the right tonsil; (3) the palate; (4) the epiglottis; (5) the tongue; (6) the nasal passage; (7) the larynx; (8) the pharynx.

The Epiglottis. — When food is swallowed, it passes down the pharynx into the œsophagus, or gullet. If it goes the wrong way, and passes down the larynx, it causes severe coughing. These two canals lie side by side, as shown in Fig. 32, at (7) and (8). How is it that food will pass down one, and air pass down the other? It is because there is a little valve at the top of the larynx which shuts tightly over the larynx whenever anything is

swallowed. It always remains open when we are not swallowing. This valve is called the epiglottis.

The Trachea.—Just below the larynx is the trachea, see Fig. 33 (3), which consists of rings of cartilage. These can be felt plainly in front of the throat. At its base the trachea divides into two branches, called the bronchi, one branch going to each lung. After entering the lungs, each branch divides again and again, until its branches are so small that it requires a microscope to see them. At the end of each little branch there is a collection of minute sacs, called air cells; see Fig. 34.

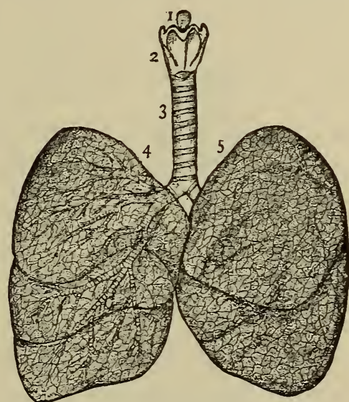


Fig. 33.—The breathing organs: (1) the epiglottis; (2) the larynx, or voice-box; (3) the trachea, or wind-pipe; (4) the right lung; (5) the left lung.

The Pleura.—The inner walls of the chest are lined with a membrane called the pleura. This membrane also covers the lungs. It pours out a fluid which keeps its surfaces moist, so that when the lungs move against the walls of the chest they can do so easily and without pain. An inflammation of this membrane is called pleurisy.

The Lungs.—There are two lungs, one in each side of the chest. Fig. 33 will help you to under-

stand how they look. They contract and expand; this is due to a tissue in them, which is something like rubber, and is known as elastic tissue. In its natural condition it is contracted; but it can be stretched out like a piece of rubber. Filling the lungs with air stretches this tissue; but it immediately contracts again, forcing the air out. From this we see that if we fill the lungs they will empty themselves.

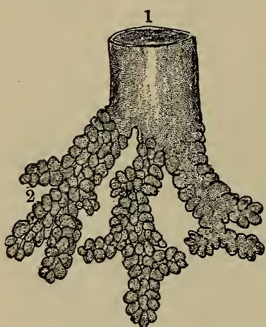


FIG. 34.—(1) the end of a small bronchial tube; (2) air cells.

How We Breathe.—Why is it that air enters the lungs? If you will watch the working of a pair of bellows, you will have the explanation. When the handles are separated the air rushes in. Why? Because the air is always pressing in every direction, and when the inside of the bellows is made larger by separating the handles, the air rushes in to fill the extra space.

The chest is a tight box, with only one opening —the larynx. Suppose we suddenly make this box larger; then more air rushes in through the opening. How is the chest made larger? The diaphragm moves down, making the chest larger in that direction, while the ribs move and make the front and sides of the chest swell out. Then the air rushes in

to fill the extra space. Trace out these changes on Fig. 35.

Inspiration.—Taking air into the lungs is called inspiration.

Expiration.—Breathing air out of the lungs is called expiration.

Respiration.—One inspiration and one expiration, taken together, are called a respiration. There are from fifteen to eighteen respirations a minute. Inspiration is caused by the enlarging of the chest, as described above. Expiration is caused by the elastic tissue contracting to its natural condition, thus forcing the air out.

Voluntary or Involuntary ?—Breathing is partly

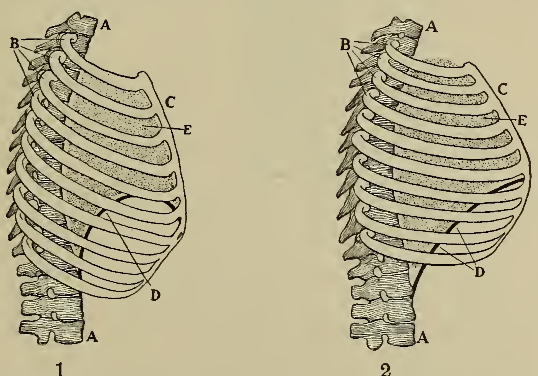


Fig. 35—Diagram showing the changes in the thoracic cavity during respiration. In (1), illustrating expiration, note the raised position of the diaphragm (D), and the position of the ribs. Compare in (2), illustrating inspiration, the lowered diaphragm and the ribs rounded outward, through which the capacity of the chest cavity (E) is increased. The ribs are hinged at (B) along the backbone (A), allowing the front ends, joined to the sternum at (C), to move upward and outward.

under the control of the will, and partly not. We breathe when we are not thinking of it, and we can for a time breathe either more slowly or faster than usual. Ordinary breathing, however, is involuntary.

Sounds of the Chest.—As the air rushes in and out of the lungs, it makes peculiar sounds. By listening to these sounds the physician is able to tell whether the lungs are healthy or not.

Blood Vessels of the Lungs.—There are a great many blood vessels in the lungs, and there are great numbers of capillaries on the walls of the air cells, so that the air and the blood come very near each other.

Why Do We Breathe?—We breathe in order to get the oxygen that is in the air into our bodies, and also to get the carbon dioxide out of the body into the air. How is this done? The red corpuscles of the blood take the oxygen from the air and carry it to all parts of the body, and the blood brings back to the lungs the carbon dioxide it has received from the tissues. Thus the blood while in the lungs receives oxygen, and gives up carbon dioxide.

The Expired Air.—Expired air contains this carbon dioxide and two other ingredients coming from the body. These are a watery vapor and an animal substance. As a rule, we cannot see the watery vapor; but on a cold, frosty morning we all say we can see our own breath. What we see is the watery vapor that has been condensed by the cold.

The animal substance mentioned is not usually noticed; yet it is sometimes very marked, and we detect it at once if we enter a poorly ventilated room in which a number of persons have remained for some time.

A Good Breathing Exercise. Raise the Arms Slowly during Inspiration; Lower them during Expiration.

Results of Breathing.—By breathing, the blood gains oxygen, and loses carbon dioxide, watery vapor, and some animal matter. The blood does not take out all the oxygen from the air in the lungs; therefore it is possible to live a short time if shut up in a small space where the same air must be breathed over again; but soon the amount of

oxygen would become too small, and the quantity of carbon dioxide too great, to support life.

Mouth Breathing.—Breathing through the mouth instead of through the nose is unnatural and injurious. It makes the throat dry, unfavorably affects the speech, and may be the cause of severe colds. We should always breathe through the nose; some children, however, are unable to breathe in this way. That may be simply because the nose is more or less closed with secretions. Children ought always to be provided with a handkerchief, which should be used freely to keep the nose clear from these secretions. Sometimes children cannot breathe through the nose because of the presence of small growths, called adenoids, in the back part of the passages of the nose. These not only interfere with proper breathing, but also cause diseases of the ears, and interfere greatly with speech. Whenever their presence is suspected a physician should be promptly consulted.

Tight Lacing.—Clothing may be made to fit the body closely and firmly without harm; but tight lacing is very injurious. It interferes with the free action of the chest, and thereby prevents the blood from getting its full supply of oxygen.

Lung Exercise.—After an ordinary inspiration we know that we can still take in more air by a special effort; and after an ordinary expiration we can still expel more air. By drawing in long and deep breaths,

and then blowing the air out slowly, we strengthen the lungs and increase their capacity; and we also more completely change the air in the lower part of the lungs. All this aids greatly in maintaining the general health, and in diminishing the danger of lung trouble. This exercise of the lungs may be taken for a few moments two or three times each day with great benefit.

Effect of Alcohol on the Lungs.—The use of alcoholic drinks tends to produce frequent attacks of bronchitis, colds, and other lung troubles. The alcohol in the blood of the drinker irritates the delicate lining of the air cells of the lungs, making them more liable to be attacked by the germs that cause disease.

Effect of Tobacco.—Tobacco is especially injurious to the lungs and throat. By its use the latter is made dry, and the voice becomes husky from the hot smoke and the poison. The membrane lining of the larynx and the bronchial tubes is also affected, producing a dry, hacking cough. The smoker's sore throat is a very common affection, and can be cured only by giving up the habit altogether. Some smokers inhale the smoke, or draw it into their lungs. This is doubly injurious.

CHAPTER XIX

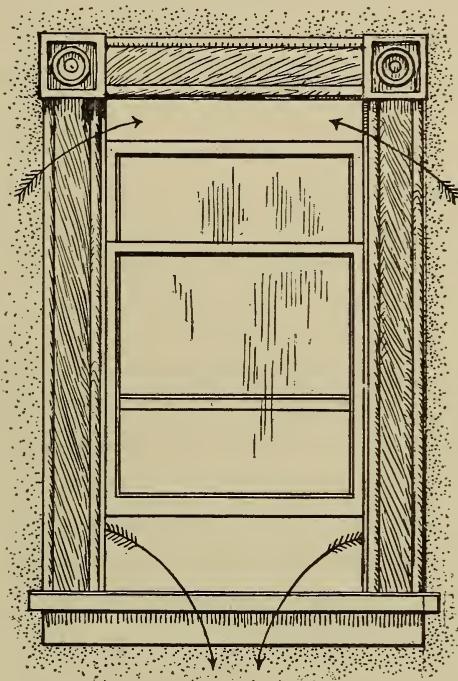
VENTILATION

As we inhale about one pint of air each time that we breathe, and as the expired air has poisonous substances in it, we should be careful to have an abundance of fresh, pure air about us all the time.

In the summer time our living and sleeping rooms are usually well ventilated. The air is warm and we naturally keep the windows and doors open as much as possible. But in the winter time we have the problem of heating the air and of changing it as well. In all properly constructed public buildings there is always some provision made whereby the air in the rooms is changed frequently and without producing draughts. It is in our own homes, and more especially in our sleeping rooms, where ventilation is usually deficient.

We must remember that cold air is not necessarily pure air, neither is a current of air always pure. The ideal rooms are those in which there is an abundant supply of fresh air all the time. In living rooms, an open grate, or a register, or a stove may cause a sufficient current.

At night, the air in the room may be easily changed by slightly raising the lower sash of the window and lowering the upper sash. If the room



To Change the Air in a Room
The arrows show how the fresh air enters and the bad air leaves the room

has two windows it is better to raise the lower sash of one and lower the upper sash of the other. Another good way, especially when the weather is very severe, or when the wind is blowing very hard, is to raise the lower sash and fit in a

board beneath it. Ventilation is secured because the two sashes do not meet; one overlaps the other.

The bed should be well aired, certainly for an hour or two before it is made in the morning. Immediately upon rising, throw all the bed clothing over a chair, open wide the windows of the room, and thus give the clothing a good airing. It is also a good rule to air during the night the clothing we use during the day.

Avoid Currents of Air.—If a current of air—a draught, as it is called—be allowed to strike on some sensitive part of the body, as the back of the neck, it is very likely to cause a cold, or something more severe. All currents of air should be avoided, especially when the body is moist with perspiration.

Odors.—It is a fact that one odor can cover up another without destroying it. The odor of flowers may cover up the odor of a poorly ventilated room. Air may be poisonous, and yet be made agreeable to the sense of smell.

Deodorizers.—Any substance that will take the place of an odor, and yet not destroy it, or the cause of it, is called a deodorizer. People sometimes burn coffee or sugar to destroy some disagreeable odor; but by so doing they only cover the odor with one more powerful.

Disinfectants.—Disinfectants actually destroy odors by destroying their cause, and are largely used by

physicians to kill disease-germs and to remove odors that are not only offensive but also injurious to health.

Absorbents.—Whitewashing a room sweetens and purifies the air, because the lime that is used absorbs certain gases. Lime and charcoal are both good absorbents.

Contagious Diseases.—The air we breathe may seem to us to be very pure because it is free from any disagreeable odor, and yet it may contain the germs of some contagious disease. By a contagious disease we mean a disease that can be carried from one person to another. The germs of such diseases as diphtheria and scarlet fever are easily carried by means of the clothing, or even in the dust of the atmosphere. A person may be exposed to a contagious disease and yet not contract it. Still it is always best to guard against the danger. Persons suffering from any contagious disease should be placed at once in a well-ventilated room, and all members of the family except the mother or the nurse should be kept away from them.

CHAPTER XX

SLEEP

All animals that have a well-developed nervous system must, at times, lie down to rest and to sleep. It is necessary that not only the brain, but also the whole body should have this rest.

Do not go to bed with cold feet. Better heat them until they are warm. If necessary, rub the feet thoroughly with a dry towel, and thus start a good circulation in them. This will bring the blood to the lower extremities, and will thus tend to reduce the amount of blood in the brain, thereby promoting sleep.

We Must Sleep.—By drowsiness and weariness we are warned that the body needs time to repair itself; and although this warning may be neglected for a time, yet if we are in health, sleep will overtake us, sooner or later, no matter where we are.

How Long Shall We Sleep.—Some persons require much more sleep than others, therefore no rule can be given for every one. Infants sleep a good part of the time. In middle life the average person requires about eight hours of sleep; before that age the time should be longer. When we cannot sleep

it shows that we are not in good condition. If one remains awake many hours beyond the usual time for sleep, the whole system feels the need, and most seriously objects.

To Produce Sleep.—Out-door exercise during the day, a light and early supper, rest during the evening, and warm feet, will tend to produce sleep. But, with all these, if the mind be filled with petty anxiety or with real care, it will not let the body rest.

Early to Bed.—The midnight lamp of the student should be thrown out of the window. Better work can be done in one hour in the morning than in two late at night. Students need much sleep. They do not need the morning nap, however, as much as they need the sleep that comes before midnight; therefore, "early to bed and early to rise" is as good a motto for the student as for the farmer.

Plenty of sleep is one of the rules that must not be broken. The night should not be turned into day, nor the day into night, in order to please our fancy. He who persists in breaking Nature's laws will pay a severe penalty; he will lose that which is more precious than gold,—a healthy body.

Lay aside your books, go to bed early, have fresh air in the room, and lie down to quiet and restful sleep. Awake with the rising of the sun, and while the brain is refreshed, take up your home studies.

CHAPTER XXI

THE KIDNEYS

The kidneys lie close to the back, one on each side of the spinal column, and above the waist line, as shown in Fig. 24. In shape they resemble a bean; in size they are about four inches long, two and one-half inches wide and an inch thick. They are composed of a number of minute tubes, which are so small that they can be seen only with a microscope.

The kidneys may be called the filters of the body. The blood is constantly flowing through them, and the tubes of the kidneys are steadily at work filtering from the blood certain materials that are very poisonous to the body. Should the kidneys fail to do their work, this poison would cause serious illness, and if their work entirely ceased, death would result.

One of the waste substances which the kidneys are obliged to remove from the blood comes from the meat we eat. Too much meat as a part of one's daily diet is therefore liable to throw too much work upon the kidneys. It is safer for most people to eat meat only once a day.

The daily bath, with vigorous rubbing to keep the pores of the skin open, helps to maintain the health of the kidneys. For if the skin is allowed to become clogged, the waste matters which should be removed through its pores must pass out through the kidneys, and this obliges those organs to do more than their share of work. Exposure to cold sometimes produces this effect by suddenly closing the pores of the skin.

Diseases of the kidneys are very common where large quantities of beer or other alcoholic drinks are daily used as beverages. A well-known German physician says that the kidneys are irritated by even moderate doses of alcohol, and it is believed to be one of the causes of Bright's disease. One result of the failure of the kidneys to remove poisonous waste matters from the blood is the painful disease called gout. An English physician says that in 1,500 cases of gout he found only one man who was a total abstainer. All the others were either moderate or immoderate users of alcoholic drinks.

CHAPTER XXII

THE SKIN

Uses of the Skin.—The skin serves as a protection to the delicate parts beneath; throws off some of the waste products of the body; and is largely concerned in regulating the temperature of the body.

Structure.—The outer part of the skin, which is composed of hard and dry cells, is called the cuticle. It contains neither blood vessels nor nerves. It may be removed by gently scraping the skin with a knife, and without causing either pain or the flow of blood. Immediately beneath the cuticle, and joined so closely to it that we often do not distinguish the difference, is the true skin, called the cutis. This is so filled with blood vessels and nerves that it cannot be pricked or cut without bringing blood or causing pain.

The True Skin.—In the true skin, or cutis, there are, in addition to the nerves and blood vessels, small muscles which contract the skin, giving it the appearance known as goose flesh. Some of the muscles, as shown in Fig. 36, are fastened to the hairs in such a way that they can make the shorter ones stand more nearly erect. In the deeper parts of the

skin are two kinds of glands,—the sweat glands and the oil glands.

The Sweat Glands.—A small magnifying glass will show the openings of the sweat glands in the ridges

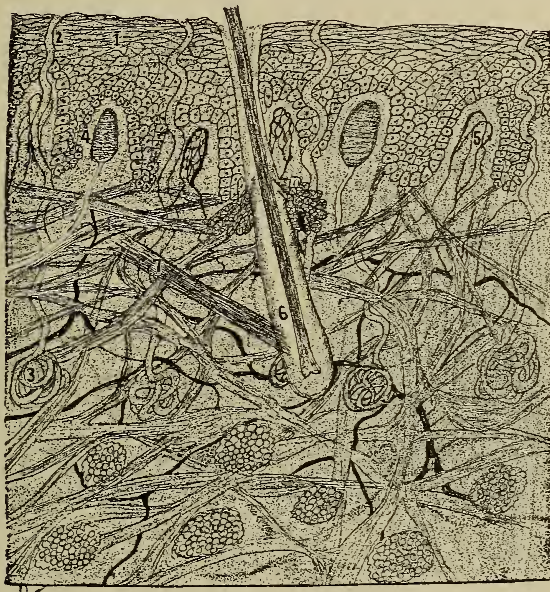


FIG. 36.—Section of human skin, magnified: (1) the outer layer, the epidermis; (2) the duct of a sweat gland; (3) the gland itself; (4) the ending of a nerve, for the sense of touch; (5) blood vessels; (6) a hair follicle; (7) muscle.

that appear so plainly on the ends of the fingers and the palms of the hands. These openings are very close together, and look like little pits, or depressions; see Fig. 37. They are the ends of tubes which go down into the skin about one fourth

of an inch, and then coil up in a round mass like a ball. There are about three millions of these glands in the whole skin. It is their work to take water and some other substances from the blood and pour them on the surface of the skin, causing perspiration, or sweat. In fevers these glands are inactive, and the skin becomes hot and dry.

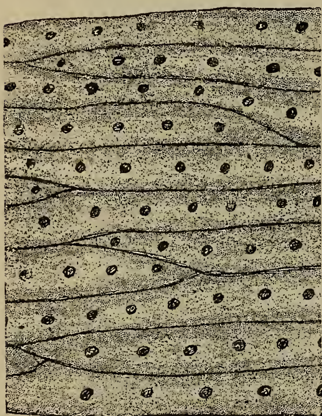


Fig. 37.—The surface of the skin magnified, showing the openings of the sweat glands.

Two Kinds of Perspiration.—What we call sensible perspiration accumulates on the surface of the body in varying amounts. This is most marked when the body is active and when it is surrounded by warm air.

Insensible perspiration is evaporated as soon as it appears on the surface. In health there is a constant secretion of this perspiration, but it is not ordinarily visible, and we are not conscious of it.

Checking the Perspiration.—The perspiration carries off certain poisonous matters with it. If the body be suddenly cooled when it has been perspiring freely, the work of carrying this matter off is at once thrown on other organs, and this frequently causes disease in them. As a result of this check,

the kidneys frequently become diseased, and the whole body may be thrown into a high fever. This is also one of the most common causes of a cold. After exercising, or whenever the body is perspiring freely, it is well to remember the following rules: Do not get chilly; do not sit in a draught; do not remain in a cool room; do not drink too much cold water; do not cool the body too quickly; let the body cool gradually, even throwing some light clothing over the shoulders while resting. To perspire freely after exercise is good; but suddenly to check the perspiration, or to allow the body to cool rapidly, is positively injurious, and may prove fatal.

The Oil Glands.—The oil glands do not come to the surface, as do the sweat glands, but each empties into a sac in which a hair rests. Thus each hair has an oily substance poured around it continually. This is nature's hair-oil. It makes the hair smooth and glossy, and, if the scalp be in a healthy condition, it will furnish oil enough to keep the hair soft and smooth.

The Hair.—The hairs are placed obliquely in the skin, as shown in Fig. 36. A hair is not hollow, as many people suppose, although in its center there is a substance softer than the outside.

The hair does not grow from the end, but from the bulb, shown in Fig. 38, which is in the skin. When one hair is removed, another will grow in its place, provided the deeper parts of the skin be in a healthy

condition. There are many diseases of the hair, some of which cause it to fall out, others to cease growing, and still others cause the hairs to split. In a great many cases, though not in all, it is possible to tell to what kind of an animal a hair belongs, by the appearance of the hair under the microscope; see Fig. 39.

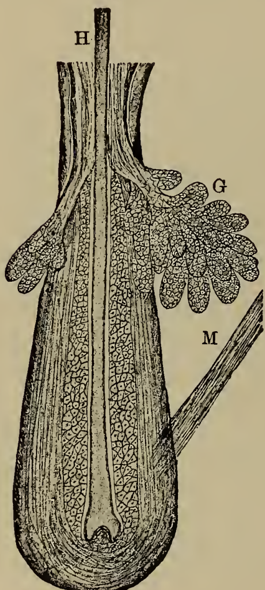


FIG. 38.—A human hair in its sheath or follicle, magnified; (H) the hair; (M) the muscle; (G) the oil gland.

Care of the Hair. — Boys should wash the head at least once a week with soapy water, rinsing the head with clear water, and then rubbing the hair with a towel until it is nearly dry. Girls may not find it convenient to do this more than once a month, owing to the difficulty of drying the hair, if it is long and heavy. This "shampooing" of the scalp keeps it clean and healthy and contributes to the growth of the hair.

The Hands.—Notice how wonderfully the hand is adapted to its purpose. Its beautiful outline and delicacy of coloring have ever made it the study of artists. We should use great care that our hands be kept as clean and neat as possible at all times

Clean hands and face, clean teeth, and well-combed hair add greatly to the appearance of any boy or girl. We sometimes grow careless, but when we stop to think about it, we must feel that a clean, neat appearance is a natural bodily evidence of a wholesome, energetic mind.

The Nails.—The nails are composed of minute cells which are very hard and firm. They protect the ends of the fingers and toes, and they give aid to the fingers in picking up small objects. The nails grow from behind forward, and they are constantly being pushed outward. The finger nails should always be neatly trimmed and perfectly clean.

Fig. 39 A, Human hair as seen with a microscope.

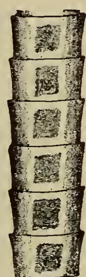


Fig. 39 B, Cat hair as seen with a microscope.

This is very easily done by the use of a nail file or scissors. Biting the nails is a very unclean and offensive habit; besides, it injures the shape of the nails.

Bathing.—Personal cleanliness is a duty that we owe to all who are around us; and we should bathe for that reason if there were no other. Bathing also is necessary to the best condition of the body. It removes oily substances, dirt, and many waste products. To remove thoroughly the natural secre-

tions of the oil glands and sweat glands it is necessary that a hot bath, with soap, be taken at least once each week. This hot bath is for purpose of cleanliness, and cannot take the place of the cool sponge bath which ought to be taken every morning. This cool bath can be quickly taken, and should always be followed by a brisk rubbing of the skin. Such a morning bath acts as a general skin tonic, and it aids in keeping the glands of the skin in a healthy condition. When the skin is inactive, then the waste products of the body, which it throws off in health, have to be carried off through other channels, as through the lungs and kidneys. There is then danger that these organs will be overworked, and so become more liable to disease.

When Not to Bathe.—We should not bathe when very tired, nor just before or after a hearty meal, nor in very cold or very hot water, or when the body is perspiring freely.

Ordinary Diseases of the Skin.—When the skin becomes diseased it should be treated by a physician. The most ordinary diseases of the skin are the hives, heat rash, eczema and itch.

The hives, or nettle rash, which appears suddenly and causes great burning and itching, is generally due to some disturbance of the digestion, and passes away when the cause is removed.

Heat rash, or prickly heat, affects the sweat glands of the skin. It is caused by working in an over-

heated room, or any other exposure to extreme heat.

The disease known as eczema, or salt rheum, usually begins as a small red spot which itches and burns, and soon has scales on its surface.

A highly contagious disease called the itch is due to the presence in the skin of minute animals, so small that a microscope is required to see them. They produce an irritation which causes intense itching, especially of the hands and between the fingers. This disease would not exist if the ordinary rules of hygiene were observed.

Contagious Diseases Affecting the Skin.—In chicken pox the rash generally appears in from ten days to two weeks after exposure to the disease. The attack is often mild, but the sick child should be isolated to protect those who are well.

After exposure to the measles it is ten days to two weeks before the rash appears. Isolate the patient. One attack usually protects against another.

In the case of scarlet fever it is often only four or five days after exposure before the rash appears. This is a serious and highly contagious disease. One attack of this disease usually protects against another.

Smallpox is a disease of the most serious nature. Like scarlet fever, it is caused by a germ and is highly contagious. Immediate isolation is necessary. As vaccination is almost always a preventive, every child should surely be vaccinated.

CHAPTER XXIII

TEMPERATURE OF THE BODY

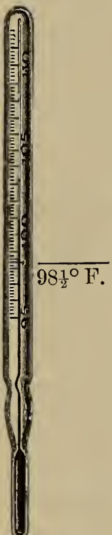


Fig. 40.—A body thermometer.

Throughout the heat of summer and the cold of winter, the body keeps at the same temperature. You may be in a very hot room one hour, and in a cold one the next; but the bodily heat will be at a fixed point; 98½° F. (Fig. 40). This heat is the result of the many changes that are taking place in the body, by which the food is made to nourish it and to furnish energy.

The temperature of warm-blooded animals, men, dogs, birds, etc., is generally above that of the air surrounding them; while the temperature of cold-blooded animals is about the same as that of the air or water surrounding them.

A Cold.—Usually a cold is caused by exposure to sudden changes in temperature, a strong draught of air coming against the back of the neck, damp clothing or wet feet. When a cold is first taken, the blood leaves the surface of the body, causing the skin to become cold and inactive. It may frequently be broken up by making the skin

warm and active again; by taking brisk exercise out of doors, or indoors if it does not seem wise to go out. When bedtime comes, if there is any suspicion of a cold, take a hot foot bath and drink a cupful of hot lemonade or hot ginger tea just before going to bed. This will send the blood to the surface of the body again and set the skin to work. Such treatment may prevent a serious illness.

To Prevent Colds.—It is not wise to "bundle up" the throat much even in cold weather. Sufficient clothing should be worn about the neck to protect it from the storm, but that is all. The best preventive of colds is a cool sponge bath each morning, which, as already suggested, should be quickly taken and followed by a vigorous rubbing. This so accustoms the system to cold that it is not nearly so liable to be affected by any change in the weather.

Never sit with wet feet, but if possible remove the damp shoes and stockings at once and rub the feet thoroughly. If this is not possible, then keep walking or exercising until the feet are dry. Whenever your clothing is damp or wet, change it as soon as possible. In the meantime keep the body from getting chilled by quick walking or some other exercise. While changing the damp for dry clothing give the skin a brisk rubbing, in order to restore it to its normal condition.

The Objects of Clothing and Food.—Food supplies heat to the body; for we have said that the heat of

the body is caused by the changes going on in the tissues,—by the changing of food into tissue. One object of clothing is to prevent too great a loss of

Barefoot Boys in Summer-Time

heat from the body; for the air surrounding the body is nearly always cooler than the body itself. It follows, then, that clothing answers a purpose similar to that of food. Food produces heat, and clothing prevents its escape. Therefore poorly fed persons need more clothing in winter than those

who are well fed. Men and animals do not need so much food when kept warm as they do when they are cold, and they can do much better work if well protected from the cold. Clothing protects the body from many injuries, from storms, and from the burning rays of the sun.

The Clothing of Animals.—The lower animals have no choice as to what they shall wear. Nature gives them an abundant covering, which in some cases is very beautiful. She sometimes changes their clothing for them, as when the horse sheds his heavy coat of hair in the spring, so that he may have a lighter one during the heat of summer. But man is left to make his own choice of clothing.

The Weight of Clothing.—Heavy clothing is not necessarily warm. Loosely knit shawls are very light, and yet very warm. There is a great deal of air confined in their meshes, and air is not a good conductor of heat.

The shoulders should, as far as is possible, be made to bear the weight of the clothing. Then the lungs and heart are not compressed, and the stomach and liver are not affected. Clothing worn in this manner does not prevent the free circulation of the blood, does not compress any organ, and does not interfere with the natural, graceful movements of the body.

Too High a Temperature.—We should avoid overheating the body and thus causing it to become

weak; overheating may be caused by wearing too much clothing, but more often by living in rooms that are kept at too high a temperature. The thermometer should not be over 70° F. in our living rooms.

Sources of Material for Clothing.—In the winter much of our clothing is made from wool; this is because woolen clothing is warmer than clothing made from either linen or cotton. In cold weather it is safer to wear wool next the skin, as it is the best safeguard against sudden changes of temperature. The wool is obtained from sheep. Many sheep are now raised in the western part of our own country. Australia is also a great sheep raising country, herds there frequently consist of hundreds of thousands of sheep. The wool is first thoroughly cleansed, then spun into yarn and then woven into cloth.

Linen is made from flax, which is the plant from which we obtain the ordinary flaxseed. Certain parts of the stalk of the flax are removed and prepared in such a way that it is easily spun into thread. The ordinary linen sewing thread is made from flax. The flax threads are made of different sizes; some are woven into cloth for clothing, table linen, etc. Linen clothing is cooler than woolen.

The cotton cloth with which we are so familiar is made from the cotton plant which is grown largely in the southern states. The cotton is first picked,

then cleansed, then spun into thread, then woven into cloth. Cotton clothing is warmer than linen.

Night Clothing.—More clothing is necessary at night, because the temperature at night is usually colder, the body is not being exercised, and the circulation of the blood is not so rapid. Good health requires that all clothing worn through the day should be changed at night.

Effects of Alcohol on Temperature.—The question we have to answer here is this: Do alcoholic drinks raise the temperature? What truth is there in such a statement as this: "It is a cold day, we must take something to warm us;" or, "We must take some whiskey with us, it will be a long drive, and we shall get very cold." These statements are made because many people think that alcohol warms the body; in other words, that it raises the temperature of the body. Is there any truth in this?

During the first effects of alcohol on the system the capillaries become distended and more blood than usual is then sent to the capillaries of all parts of the body. More warm blood than usual goes to the skin at the surface of the body, and the nerves in the skin are thus made to feel distinctly warmer.

The internal parts of the body, however, are seldom if ever made any warmer by alcohol, and if so only a fraction of a degree and for a very short time. The feeling of increased warmth, also,

is only temporary, for while it lasts the body is actually becoming colder. The reason for this is explained as follows:

By sending more warm blood than usual to the surface of the body, more is exposed to the surrounding air, which is almost always below $98\frac{1}{2}$ degrees, the temperature of the healthy body. The result is that the blood, and the internal parts to which it returns, are thereby obliged to give up their heat more rapidly than before this disturbance. As a consequence the body as a whole becomes more quickly cooled. From this it is easy to see why it is particularly dangerous for one to take any alcoholic drink before going out into the cold, or while exposed to severe weather.

The teachings of science in this matter are abundantly confirmed by the testimony of experience.

CHAPTER XXIV

THE NERVOUS SYSTEM

The nervous system consists of the brain, the spinal cord, and the nerves.

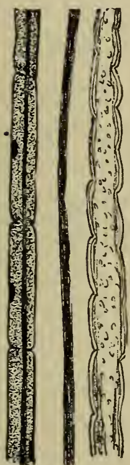


FIG. 41.—Nerve fibers, magnified.

The Brain.—The brain is a large mass of nervous tissue filling the cavity of the skull. It is well protected by membranes which completely surround it, and by the strong walls of the skull itself. The surface of the brain is not smooth, but is thrown into irregular ridges. It is full of blood vessels, some of which are quite large; but the majority are minute capillaries.

The White and the Gray Matter.—The brain consists of two kinds of nerve matter,—the white and the gray matter. The former is composed largely of nerve fibers (Fig. 41), while the latter consists principally of nerve cells (Fig. 42). The gray matter is on the outside of the brain. It is the gray matter that commands, while the white matter obeys. Thoughts first arise in the gray matter; the white matter conveys the messages to the different parts of the body.

The Cerebrum.—The part of the brain above the ears is called the cerebrum, or the great brain; the part at the back of the head, beneath the cerebrum, is called the cerebellum, or the lesser brain. It

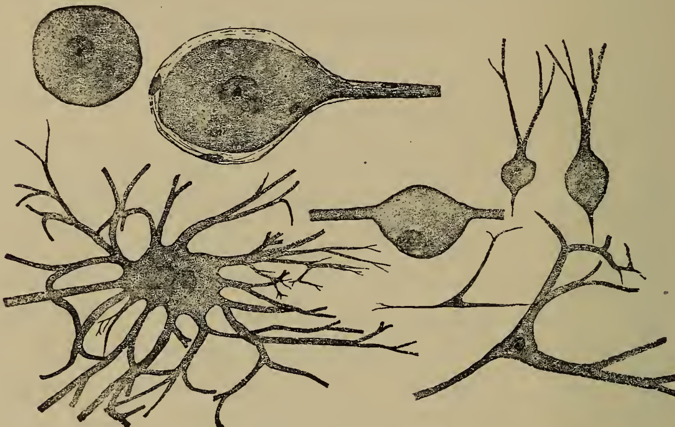


Fig. 42.—Various forms of nerve cells.

is supposed that the cerebrum is the abode of the mind. Here we think, and know, and reason.

The cerebrum (Fig. 43) is divided into two parts by a natural groove in the middle, passing from the front backwards. From this it would seem that we have two brains,—a right brain and a left brain. But at the bottom of this groove the halves are united by a band of nervous tissue, so doubtless their action is in some way connected. The ridges, or convolutions, of the cerebrum vary in different animals, see Fig. 45. As a rule, the more intelligent the animal, the more numerous are

these convolutions, and the deeper the depressions between them.

The Weight of the Brain.—The brain of the elephant is the heaviest known. It weighs from eight to ten pounds. The brain of the whale comes next, and weighs from six to eight pounds. The average weight of the human brain is, for the male, a trifle over three pounds, and for the female, about one third of a pound less.

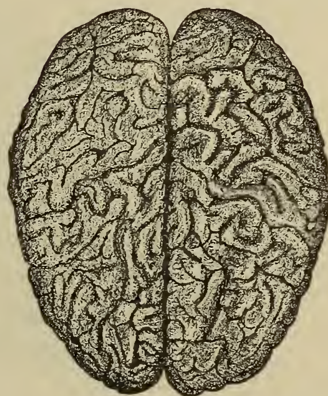


Fig. 43.—The human brain (reduced), viewed from above; only the cerebrum is seen.

Something More Than Brain Needed.—A man may have a large and fine brain, a healthy body, and be in every other way fitted to succeed in life, and yet lack the desire to put his powers into action. We say that such a person has no ambition. He is disposed to take life too easily. In addition to a healthy body and a good brain, we must have a desire to work,—an ambition to do the very best we can in all we undertake. We must remember that the brain works, hence it wears out like any other tissue; it must therefore be kept well supplied with new material. School children need plenty of plain, wholesome food, and an abundant supply of fresh air.

The Cerebellum.—The cerebellum is beneath the back part of the cerebrum. It has no convolutions, although there are ridges running over its surface parallel to each other (Fig. 44 (2)).

The Medulla Oblongata.—At the upper end of the spinal cord, and between it and the brain, is an

FIG. 44.—Side view of the whole human brain: (1) cerebrum; (2) cerebellum; (3) medulla.

enlarged part of the spinal cord, called the medulla oblongata, or the bulb. It is well protected by the thick bones at the base of the skull. This part of the brain controls the breathing and regulates the action of many parts. It must be regarded as the most delicate portion of the whole body. The cerebrum, or the cerebellum, may be entirely removed without immediately destroying life. Portions of the cerebrum, cerebellum, or spinal cord may be

removed, and recovery follow. But if the medulla be destroyed, death will follow instantly.

The Spinal Cord.—The spinal cord is nearly circular in shape, about eighteen inches in length, and half an inch in thickness. It connects above with the medulla, and terminates at the lower end of the spinal column in a number of fine threads. The spinal cord, like the brain, is divided into halves. A groove or fissure extends down its front and another down its back, nearly dividing it. From each half, or each side, of the cord, there are given off thirty-one nerves. Study Fig. 46.

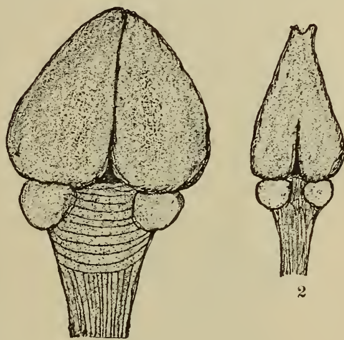


FIG. 45.—(1) Brain of pigeon; (2) brain of frog,—both viewed from above. There are no convolutions on the cerebrum.

Structure of the Cord.—The cord is composed of gray and white matter, similar to that in the brain, but here the gray matter is in the center of the cord, and is collected together in such a manner that when the cord is cut across the gray matter resembles the letter H (Fig. 47). The nerve fibers go up and down the cord, and carry messages to and from the brain. After entering the brain these fibers are distributed through all parts of it, and are connected with the nerve cells.

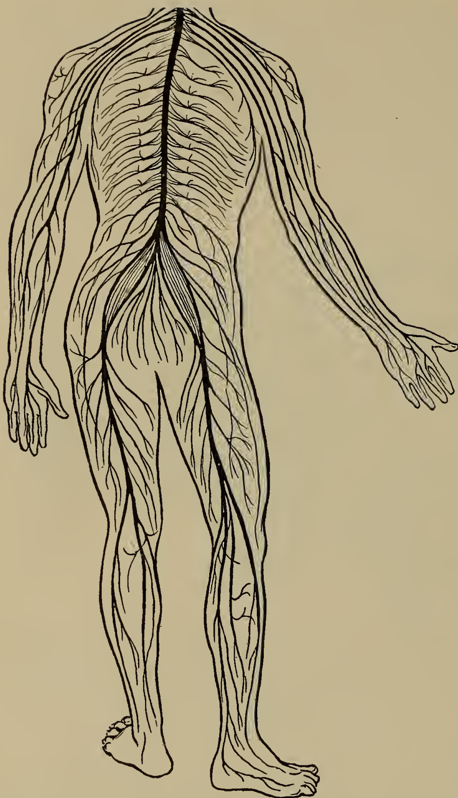


FIG. 46.—The nervous system, showing the spinal cord and the main nerves branching from it. The grooves in the cord are not shown.

The Nerve Centers. — The brain and the spinal cord are called the nerve centers. From these the majority of the nerves take their origin.

The Nerves.— There are two kinds of nerves, —the sensory, or nerves of feeling, and the motor, or nerves of motion. The sensory nerves carry messages from different parts of the body to the nerve centers. They convey to the brain impressions made on the tongue that something is sweet or sour; or impressions made on the ear by harsh or gentle sounds; or on the eye by colors. These impressions are made on the outer ends of the nerves; the nerves

carry them to the spinal cord; then up the cord to the brain, where, in some mysterious way, we are made aware of what is going on at the distant ends of the nerves.

The motor nerves convey messages in an opposite direction, that is, from the nerve centers outward to the muscles, causing them to contract or relax.

Each one of the spinal nerves is connected with the cord by two roots. One root enters the front of the cord, and is composed of motor nerves; the other enters the back of the cord, and is composed of sensory nerves.

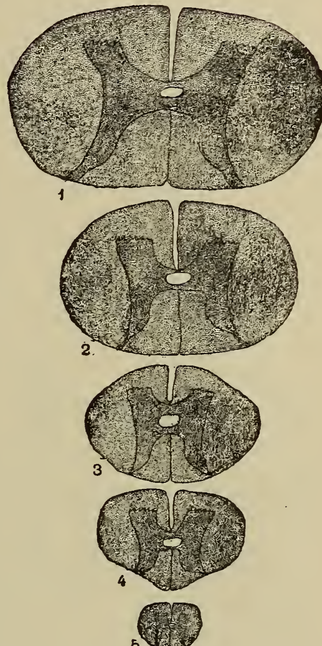


Fig. 47.—Cross sections of the spinal cords of different animals, represented twice the natural size: (1) horse; (2) ox; (3) man; (4) hog; (5) squirrel.

Reflex Action.—Reflex action is well illustrated by tickling the foot of a person who is asleep. The foot will be quickly drawn away, and yet the mind will know nothing of it. Fig. 48 illustrates how the sensation or impression goes from the skin of the foot to the spinal cord by one set of nerves, and how a message is sent from the

spinal cord down to the muscles by another set of nerves.

The spinal cord is the great reflex center. Impressions carried to it by the sensory nerves are acted upon, as just shown, without going to the brain. Even the will is not strong enough to control all the reflex acts, for if we inhale pepper, we either cough or sneeze, and cannot prevent it. It is purely a reflex act. We may determine not to sneeze, but it is of no use.

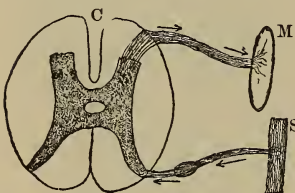


Fig. 48.—A diagram illustrating reflex action: (S) the skin; (M) a muscle; (C) section of the spinal cord. The arrows represent the direction of the nerve current during a reflex act.

The Nerve Current.—The peculiar power carried by the nerves is called the nerve current, or nerve force. It travels along the nerves at the rate of over one hundred feet a second. We do not know what this nerve force is, although we can interfere with its action. We may be seated in a cramped position, so that some nerve is pressed; the nerve current is disturbed, and when we try to move the leg we feel pain. We say the leg is asleep. It may be impossible to move the leg at first, owing to a complete stopping of the current.

Study is a Healthful Exercise.—The cerebrum is generally regarded as the seat of the mind. We know that there is a very general law that the proper exercise of a part tends to make it grow

and develop. It is possible, therefore, by properly exercising the brain, to aid the growth and development of the intellect. While the mind can be greatly improved by exercise, it can also be injured by over-exercise. Study, under the right conditions, is a healthful exercise.

The Sympathetic System.—This system consists of a number of little masses of nerve cells and of nerve fibers. The little masses of cells are placed on the sides and in front of the whole length of the spinal column. They are connected with one another by means of the nerve fibers. Nerve fibers also connect them with the spinal cord and the brain.

The sympathetic system exerts its influence over the minute blood vessels, causing these to contract or expand. A good illustration of this is seen in the act of blushing, which is the result of the influence of the sympathetic nerves in allowing the minute blood vessels of the face to expand and become more filled with blood. The opposite effect is shown when the blood vessels of the face are contracted so that they contain but little blood, as when the face is very pale from fear. The sympathetic system also controls, to a greater or lesser degree, the various processes of digestion and nutrition, and other functions of the body, which are carried on without our giving any attention to them.

The medulla also has control over the size of the minute blood vessels.

CHAPTER XXV

ALCOHOL, TOBACCO, OPIUM, AND THE NERVOUS SYSTEM

If the effects of alcohol on the nervous system were only more fully understood before the desire for it is created, its use as a beverage would be greatly diminished. There are many persons who begin to take some form of alcoholic beverage because they are asked to do so by others whom they do not like to refuse. Or they find themselves in the society of those who use such drinks, and the desire to be social and popular leads to a compliance with the general custom.

Others begin to drink some form of alcoholic liquor because they have been led to think that it may do them good. They are in poor health, yet hardly wish to consult a physician, so they take some alcoholic drink, as beer, or wine, hoping thereby to improve their appetite and strengthen their digestion. Failing to receive immediate benefit, they continue the use of these intoxicating drinks until a habit is formed. When the system has been under the influence of these drugs for a considerable length of time, the effect is such that the person believes he cannot live without them.

He may, however, try to go without his drinks for a time, but they have made an impression upon his nervous system and he finds it almost impossible to throw off their paralyzing effects.

One of the most striking things about alcohol is its peculiar effect on the nervous tissue of the brain, the spinal cord and the nerves. Indeed we may go further than this and say that alcohol seems to have a special attraction for the nervous system. To explain this it is only necessary to say that some drugs when taken into the system exert almost all of their power on the liver, others on the kidneys, others on the skin, and so on. Now when alcoholic drinks are absorbed into the blood and carried to all parts of the body, the nervous tissue is acted upon more powerfully than the other tissues. In other words, when alcohol is taken it is carried to all the tissues, but more goes to the nervous tissue, in proportion, than to any other tissue. We may say that alcohol has a special attraction for this tissue.

We must keep in mind that alcohol is a narcotic; it benumbs, paralyzes, stupefies. It may not completely paralyze the whole system, but to a greater or lesser degree it diminishes the power of the muscles, deadens sensation in parts of the body, interferes with the action of the spinal cord, and prevents the brain from doing its best work.

Although alcohol really benumbs or paralyzes

nerve tissue, it appears at first to excite the person who takes it. But this excitement is not the healthy, trustworthy activity of a sound brain. It is an untrustworthy mental condition in which the judgment, the reason and the conscience do not control the words and the conduct as they should. This unhealthy excitement of the brain is followed by a reaction which leaves the brain in a weaker condition than before. Here again is another reason why one dose of alcohol so often leads to another. When the period of excitement has passed the body feels weak and exhausted and the temptation to take more is often too great for the person to overcome.

To show that alcohol has a direct effect on the spinal cord, it is only necessary to watch a person who is under its influence as he attempts to walk the street. He has to think of his walking, as he cannot think of something else and walk also. He thinks intently about the movements of his limbs, in order to make them correctly. Yet he may think ever so hard and not be able to control the action of his muscles, because the spinal cord is partly paralyzed from the alcoholic poisoning.

Some persons cannot take even a small glass of brandy or whiskey without acting in a very disorderly way. The alcohol seems to expend its power largely on the brain and spinal cord. To produce the same effect on others, especially those

who are in the habit of taking alcoholic drinks, larger doses are necessary. Yet it may be truthfully stated that in all circumstances and under all conditions the nervous system suffers from the effect of alcoholic liquors more than any other part of the body.

Notice how the brain of a man under the influence of an intoxicating drink is affected. His sentences are broken and his ideas confused. His brain is over-excited and his will has lost the power to command. Reason has stepped aside and now the merely animal part of the man's nature assumes control. The cruel man becomes more cruel, the untruthful more false, and the vile man shows his true disposition. The muscles respond to commands but feebly, and the limbs scarcely support the body. Words cannot be formed and only confused sounds escape. If these effects extend but a little further, the brain is completely overpowered, the voluntary muscles cease to act, sensation is lost, and the body becomes a mere senseless mass of flesh.

As a rule, the brain loses its power before the heart; that is, when death occurs from almost any cause the person will become unconscious before the heart ceases to beat. So the person who indulges in strong drink often has his life spared because he is made unconscious before he has taken enough poison to stop the beating of his heart. If he could drink more he would probably do so; but being

unconscious he cannot, and thereby nature is given time to throw off the poison before a fatal effect is produced. Did the heart fail before the brain, then the number of immediate deaths from alcohol would be greatly increased.

Yet many people use intoxicating drinks as a beverage who never become intoxicated. This brings us to the question whether moderate and frequently repeated doses of alcohol have any serious effect upon the nervous system. There is without doubt a direct effect of alcohol on the nerve tissue itself. When alcohol is taken into the system it is carried to all parts of the body, hence some of the alcohol must be carried directly to the delicate structures of the brain. This direct effect of the alcohol on the brain cells must be very marked, while the indirect effect on the brain produced by changes in its supply of blood is also a prominent factor.

The high-power microscope and staining processes of recent times have shown that alcohol causes a shrinking of the delicate ends of the nerve branches. A medical writer says, in speaking of the effect of alcohol as a medicine, that when a person has long been under its influence "the nerve cells of the gray matter are more or less fatty and shrunken." He further says that as a result of the shrinkage of these cells and of the other tissues of the brain also, "the whole cerebrum becomes smaller and the space thus made becomes filled with a watery fluid." The

use of alcohol results in impaired mental power, muscular trembling, and a shambling gait.

The injury to the brain by alcohol tends to a loss of moral sensitiveness. A person in this condition is usually indifferent as to the influence which his example and precept in favor of moderate drinking may have in leading others into peril and ruin.

Eminent physicians tell us, as the result of their long study and experience, that men who drink are more liable than total abstainers to be attacked by disease; and further, that they have less power to resist disease.*

Delirium Tremens.—This disease may be caused by a single intoxication, but usually it is the result of long continued use of alcoholic drinks. It is one

* Dr. A. Baer, an eminent German physician, writes: "The liabilities to sickness are greater among drinking men than among abstainers, because alcohol weakens the vitality, lessens the power of resistance, renders the body more susceptible to disease. For these reasons it is strikingly true that in times of epidemics, sickness and mortality occur most and first among drinking men."

The Lancet, a leading English medical journal, says: "It is not only that alcohol causes disease of the gravest character directly, but that by the general misery and innutrition of families which it involves, it favors all other degenerations."

Professor Fick, a great German teacher of physiology, said, not long before his death: "The inexorable reaper is at work with his scythe mowing down families attached to alcohol and sparing those that are armed with either a natural or an acquired dislike for the poison."

The *Journal of the American Medical Association*, a leading medical paper in this country, said recently: "Every physician who is a

of the most terrible of all the effects of alcohol. The victim is wild with fear and dread of imaginary creatures which he fancies are trying to do him harm.

Effect on the Mind.—One of the first, and yet one of the most serious effects of alcohol is that it greatly weakens the will power, while at the same time it increases the desire for more alcohol. The slightly intoxicated man goes about the streets singing and laughing in a very silly way. He is easily provoked, does very rash things, and becomes an object of sport to thoughtless boys.

general practitioner has had frequent opportunities of observing how readily those who are habitual drinkers succumb to disease. This fact is well demonstrated in military life, as well as by those who endure great hardships in exploration and navigation; neither can alcoholics stand the extremes of heat and cold as well as the non-alcoholic."

Professor Woodhead, of Cambridge University, England, says: "It has been proved that even healthy people taking alcohol have their power of resisting disease of various kinds very materially diminished in the process."

Dr. A. Forel, a noted physician of Switzerland, says: "Diseases of all kinds are hastened and run a more serious course, often a fatal one, in consequence of the habit of drinking alcoholics."

A number of leading physicians in Germany, not many years ago, drew up and signed a public declaration which contained, among others, the following statements:

"It is an absolutely scientific fact that alcoholic drinks more than any other factor injure our national life, diminish the physical and intellectual forces of our race, impregnate them with hereditary diseases and lead to degeneracy. . . . Moderation, as it is generally understood, predisposes man in an appreciable manner to certain maladies and shortens life. . . . "

Consider a man who is honest and kind when sober. Who can tell what he will do when under the influence of the alcohol poison? If the drinking be continued, the will power sooner or later suffers. The desire for drink becomes greater and greater until nothing will be thought too dear to exchange for it. The records of crime show that a large percentage is committed by persons under the influence of liquor. Indeed, the effect of alcohol is to lead men to commit deeds from which they would shrink if they were in their right minds. While such results follow the use of alcohol in large quantities, yet the frequent use of small doses may also impair the mind.

Tobacco.—Tobacco frequently produces a feeling of nervous restlessness, which is most noticeable when the person, for some reason, does not indulge in his usual smoke. We have already seen how it produces such an effect on the nerves of the heart as to cause a particular kind of trouble, called the tobacco heart.

Opium.—Opium affects all parts of the body, but especially the nervous system. Under its continued use the memory fails, and there is a partial paralysis of the lower limbs, giving a stooping appearance. A distaste for food follows, the stomach refuses to act, and in many cases death results. A marked feature about the opium habit is that its victim has an almost irresistible desire to repeat the dose. The

amount must be gradually increased to produce the desired effect, until sometimes the quantity taken is enormous. Under the influence of this drug, the sense of right and wrong is sadly blunted, the mind is weakened, and the whole body is thrown into a dazed stupor, unfitting the victim for any sphere in life.

CHAPTER XXVI

THE SENSE OF SIGHT

The Eye.—The eye is well protected in a deep socket of bone. The brows project over it, and are covered with thick hair, which lies in such a direction that the perspiration from the forehead will be carried to each side of the face, and will not run into the eyes. Directly in front of the eyes are two curtains, which can be quickly and freely moved. These are the upper and lower lids. The upper lid can be moved much more freely than the lower. The lids have a row of delicate hairs on their edges, called eyelashes. These are of great use to the eye, even in the dark; for if an insect or any particle of matter comes in contact with the eyelashes, the eyelids close at once, preventing the harmful object from touching the eye itself.

The eyelids protect the delicate eye from heat and cold, they keep out dust and dirt, they regulate the amount of light to be admitted to the eye, and they spread over the eyeball the moisture from the tear glands.

The Oil Glands.—There are many small glands in the eyelids which secrete an oily substance

that flows over the edges of the lids and keeps them from adhering to one another. It also tends to keep the tears from running over the edges of the lids and down upon the face.

The Tear Glands.—Tears are secreted by two small glands, the lachrymal glands. Each gland is found at the outer and upper part of the eyeball, between the eyeball and the bone (Fig 49). The secretion is a constant one, and the fluid is distributed over the eyeball by the movements of the eyelids. Some of this secretion is evaporated from the eyeball, but the greater part is carried away through two openings. There is one opening in each lid on the side next the nose. The one on the lower lid may easily be seen by looking in a mirror and slightly pulling the lower lid down. The two openings of each eye enter a duct or canal which passes into the nose. Generally the tears pass through this duct, but sometimes more are secreted than can pass through it;

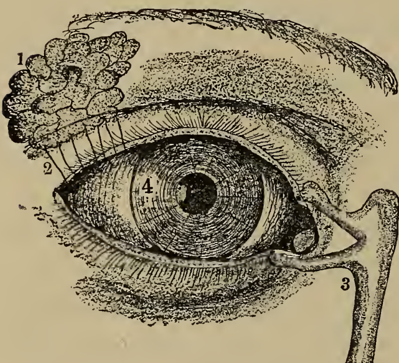


FIG. 49.—(1) the lachrymal gland that secretes the tears; (2) the ducts that carry the tears from the gland to the eye; (3) the duct for the passage of the tears to the nose; (4) the iris; the pupil is the black spot inside the circle of the iris.

then they flow over the eyelids and down upon the cheeks.

The Eyeball.—The eyeball is a round body with many membranes, or coats, surrounding it. The illustration (Fig. 50) shows that the eyeball is not perfectly round, for the front bulges out. This front and highly curved part is transparent, and through it the light readily passes.

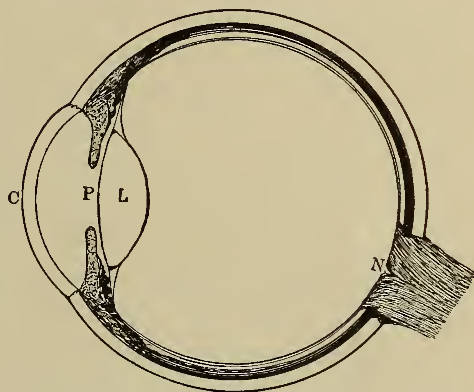


Fig. 50.—(P) the pupil; (L) the lens; (N) the optic nerve; (C) the cornea.

The colored circle of the eye, which makes it appear black or brown or blue, is called the iris. It is found in the middle of the eye, with a circular hole in its center, called the pupil. See Fig. 49.

By the action of certain muscles the size of the pupil may be changed. If the light is too bright, the pupil will be made smaller, so that but little light will reach the back of the eye; but if the light is very dim, then the pupil will enlarge, in order that as much light as possible may reach it.

The pupil is not found in all animals; in the cat it is simply an upright slit when it is contracted,

but round when it is fully opened. It may become so large in this animal that enough light enters the eye to enable the cat to see when it is so dark that we cannot.

How We See.—The light enters the front of the eye, passes through the pupil, then through the lens, and lastly strikes a delicate membrane at the back of the eye. This membrane is directly connected with the brain by means of the optic nerve. When we look at an object, an image of it is made on this delicate membrane, and the optic nerve conveys the impression to the brain. If we cut the optic nerve, and thus sever the connection between the eye and the brain, the image is made on the eye exactly as before, only the brain has no knowledge of it. The eye may be compared to the camera of the photographer; it is the photographer who sees, not his camera. So it is the brain which sees, not the eye.

Care of the Eyes.—There are many causes of trouble with the eyes. If the whole body is weak, the eyes also are likely to be weak. They are then easily tired, and the ordinary use of them may cause them to become inflamed. As inflammation of the membranes of the throat is caused by a cold, so the delicate membrane covering the front of the eye becomes inflamed from the same cause. The eyes feel as if there were sand in them, and at times they are used only with great pain. Whenever the eyes are inflamed, when their use causes pain, or when

reading causes headache, a competent physician should be consulted, to discover what the trouble is, and to remedy it, if possible.

It is a terrible misfortune to be blind, and very sad to have the eyes so weak that the pleasure of reading and studying must be denied. We should therefore use every possible care to guard against such misfortune. The following suggestions may aid one in preserving good eyesight:

Do not read by twilight.

Do not use the eyes when they feel tired.

The light should be clear and steady; neither dim nor very strong.

Never look directly at the sun nor at a brilliant light.

Do not read when lying down; the upright position is the natural and proper one.

Do not read when riding in the cars or in a carriage, or while walking. The eyes become quickly tired from the irregular muscular action.

Do not look too long at any one thing. Rest the eyes by looking around at frequent intervals.

Squinting may result in serious trouble, as it strains some of the muscles of the eye.

Do not face the light when reading in the evening. Put a shade on the lamp, and let the light come from over the shoulder.

Do not allow strong sunlight to fall on the eyes upon first awaking in the morning.

A book should be held at twelve to sixteen inches from the eye when reading.

Have any object that may have fallen into the eye removed as quickly as possible.

Never rub the eyes to remove dust or dirt. These may be removed by carefully wiping the eye with a folded corner of a soft handkerchief.

Avoid reading and studying if the eyes are inflamed.

Never use ointments or eye-washes without the advice of your physician.

Alcohol and the Eyes.—The bleared eyes of the hard drinker are one of the tell-tales of his habits. The blood vessels are filled to their utmost with blood, making the eyes look blood-shot. This condition is likely to continue as long as alcohol is taken. If its use is stopped, under proper treatment the inflammation may be relieved or entirely cured.

Tobacco and the Eyes.—The smoke of burning tobacco is very irritating to the eyes, and red edges to the eyelids are often seen among smokers. In serious cases of this trouble arising from the use of tobacco there are sharp pains in the eyeballs, and the sight is greatly affected.

When the children complain of constant headache, especially if there is pain in the eyes as well, an oculist or physician should be consulted in order to determine whether there may not be some trouble with the eyes requiring the use of glasses.

CHAPTER XXVII

THE SENSE OF TASTE

The sense of taste is made possible to us largely by means of the tongue. The lining membranes of other portions of the mouth may have something to do with it, but it is principally due to the membrane on the upper surface of the tongue.

The Tongue.—The tongue, which is composed of voluntary muscle, is easily moved in any direction. When the body is in a healthy condition, the tongue is moist and of a light red color. A dry tongue denotes fever, while a furred tongue is pretty sure evidence of some disturbance of the digestive organs; a bright red tongue also is a symptom of disease. Therefore by the appearance of the tongue the physician can learn something of the condition of his patient.

The healthy tongue is covered, on its upper surface, with minute elevations, called papillæ. The largest of these are found on the back part of the tongue. They are arranged like the letter V, with the point of the V toward the back (Fig. 51). Other and smaller papillæ are easily seen, scattered over the tongue. Some of these papillæ act as organs of

touch, for the tongue has the sense of touch just as the skin has. Other papillæ act as taste organs, and are connected with the brain by means of nerves.

We cannot taste any substance until it is dissolved. If dry sugar is placed on a dry tongue, the sugar cannot be tasted at all. The saliva aids in dissolving the substance we taste, and the movements of the tongue spread the substance over its surface.

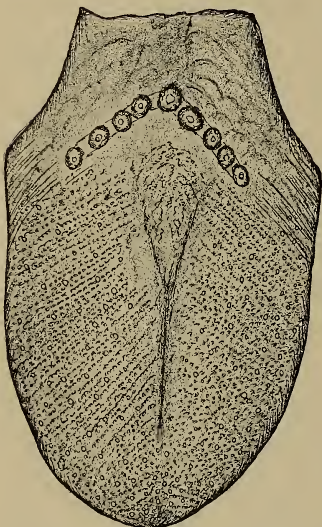


FIG. 51.—The tongue, showing the varieties of papillæ.

Smell and Taste.—The sense of smell frequently confuses the sense of taste. We think we taste a thing when really it is the odor which is the more prominent. In taking medicine that we dislike because of its unpleasant taste, we often find that if we close the nose we can take the medicine without trouble. In this case it is the odor we need to get rid of rather than the taste.

Flavors.—If the eyes and the nose are closed, the taste of an onion may be mistaken for that of some pleasant fruit.

We may become so accustomed to the taste of

certain articles of food as to think them very agreeable, although at first they were very disagreeable to us. Many persons who at first dislike the taste of tomatoes or olives, or even oysters, soon learn to like them very much.

Only one flavor can be appreciated at a time. If more than one is tried at a time, the result is a confused taste. A strong flavor may so affect the taste organs that a weaker flavor may immediately follow it without being noticed. Advantage is often taken of this in giving medicine. A strongly flavored fluid is taken into the mouth, and immediately afterwards the disagreeable dose is swallowed, followed by more of the strong flavor first used.

The practice of eating cloves and other spices is a very harmful one, as it is likely to destroy the sense of taste and seriously disturb the action of the stomach.

CHAPTER XXVIII

THE SENSES OF SMELL AND TOUCH

The Sense of Smell.—When certain substances are brought near the nose they produce a peculiar sensation which we call an odor.

The sense of smell is of great service to us in many ways. When we are conscious of any bad smell in the air, we know that it is unfit to breathe; when food has a tainted odor, it should not be eaten. Many of the disagreeable odors come from substances that are harmful to the body, while agreeable odors come from substances that are frequently not only pleasant, but healthful also.

Some odors may be carried for a long distance. It is said that persons on board vessels at sea have detected the odor of cinnamon growing on a shore over two hundred miles away.

The Sense of Touch.—The sense of touch resides principally in the skin, and in the mucous membranes of the nose, mouth and throat. It may seem to us most natural that we should feel anything we can touch. But this sense of touch is not so simple. We owe it to sensory nerves found in the papillæ, which we have already located in the outer skin.

These papillæ are found in greatest numbers on the tips of the fingers. In each one of them is a fine little sensory nerve that transmits its story whenever it is touched.

Acuteness of Sensation.—We may easily discover for ourselves which parts of the body are the most sensitive. Take two pins and hold their points at least an inch apart. Press them lightly against the skin on the back of the wrist of another person, being careful that both points come in contact with the skin at the same time. Repeat the experiment, bringing the pins a trifle nearer together each time. Soon the sensation will be as if only one point were touching the skin. Note now how near together the points are. Try the same experiment on the inside of the first finger. It will be found that the points may be brought much nearer together before the two points will be felt as one,—which shows that the sense of touch is much more delicate at this place.

The Education of Touch.—The sense of touch may be highly developed. Blind persons can read very rapidly by passing the fingers over the pages of raised letters; their sense of touch is so delicate that the form of the slightly raised letter is made very clear to them.

The Sense of Temperature.—Whenever our bodies come in contact with a substance, we are able to tell whether it is hot or cold. This is because we

are in possession of a sense called the "temperature sense." This sense is situated in the skin, and in the delicate mucous membranes, like those of the mouth, the throat, and the nose. The temperature sense, like the muscle sense described below, is sometimes classed as a distinct sense, and sometimes as a particular form of the sense of touch.

The Muscle Sense.—The muscle sense tells us how strongly our muscles contract. As the muscles must contract more strongly in order to lift a heavy object than a light one, so this muscle sense enables us to judge of the differences in the weight of bodies. The muscle sense resides in certain nerves which are present in all parts of the body.

Feelers.—Many of the lower animals are provided with "feelers," in order that they may detect an object near them. The whiskers of the cat are probably for this purpose. The skin of that animal is so covered with hair that it can be of but little use as an organ of touch; therefore Nature has given it a few very long hairs, called "feelers." These feelers are fastened deep in the skin, and are attached to nerves which convey impressions directly to the brain.

CHAPTER XXIX

THE SENSE OF HEARING

The organs of hearing are among the most difficult parts of the body to understand. We see only the outer ear, but there are two other parts—the middle ear and the inner ear. Study Fig. 52.

The Outer Ear.—The outer ear is the peculiarly shaped piece of cartilage on the side of the head by means of which we catch sound waves. This is very easily seen to be true of the lower animals: they always turn their ears in the direction from which the sounds come. Even man is governed by the same principle, and when his hearing is not acute he will place his hand behind his ear and push it forward, at the same time making the sound-catching surface larger by adding to it the width of his hand. The auditory canal, which is a part of the outer ear, and leads to the middle ear, is about an inch in length.

The Middle Ear.—At the farther end of this canal is a thin membrane, the drumhead; on the inner side of this membrane is the cavity of the middle ear, which is filled with air, and is connected with the throat by means of a canal called the Eustachian

tube. Through this tube air is admitted into the drum.

The drumhead completely separates the outer and middle ears. When sound waves strike the drumhead, they cause it to vibrate,—much as the

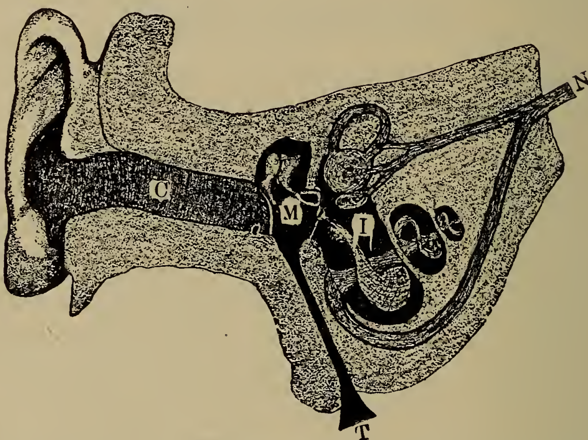


FIG. 52.—The ear: (C) the auditory canal, that leads to the middle ear; (M) the middle ear. The drum-head is the curved white line to the left of the letter M; (I) the inner ear; (N) the nerve of hearing, going to the brain; (T) the tube leading from the middle ear to the upper part of the throat.

head of an ordinary drum does when struck. This vibration shakes the three small bones that are found in the middle ear. They in turn transmit the vibration to the inner ear.

The Inner Ear.—The inner ear contains the nerve of hearing, called the auditory nerve, which conveys the nervous impulse to the brain. This part of the

ear is carefully protected by being placed within a solid bone.

Causes of Deafness.—We have spoken of a passage leading from the middle ear to the throat. We can understand now how it is that throat diseases often cause deafness, for the inflammation may readily extend from the throat along the Eustachian tube until it reaches the middle ear and affects it.

Blows on the ears are always dangerous, and may cause sudden and permanent deafness. Cold air, blowing into the ear will cause an inflammation which will affect the hearing. Shouting or speaking loudly in the ear often affects the hearing. Should an insect get into the ear, have a competent person gently pour in a little sweet oil; this will either kill the insect or drive it out.

Ear Wax.—Certain glands, situated just within the entrance of the outer ear, secrete a substance called ear wax. This wax is for the purpose of preventing the entrance of insects, and for catching the dust that is in the air, thereby protecting more delicate parts of the ear within. The frequent use of a pin, a hair pin, the end of a pencil, or other hard instrument, in endeavoring to remove this wax, is most unwise, and is often a cause of deafness. The wax is easily removed by simply twisting the corner of a towel, lightly moistened with water, and wiping out the ear.

CHAPTER XXX

THE EFFECTS OF OPIUM

Opium is made from the juice of a plant called the white poppy, which is largely grown in India and China. Cuts are made in certain parts of the plant, from which a white, milky juice escapes. This is allowed to dry, when it is gathered as a brown, thick gum. This gum is opium. From opium are made such drugs as morphine, laudanum, and paregoric.

How the Habit is Formed.—In this country, as a rule, opium is first taken, by the advice of the physician, to relieve pain. If the pain returns as soon as the effects of the drug have passed off, another dose is taken, so that if the pain continues for weeks, and the use of the opium is continued also, the habit is formed, and the drug is taken long after all necessity for it has passed away.

Its Effects.—Opium does not make its victim wild and uncontrollable, as alcohol often does; therefore its first effects do not show as plainly as those of alcohol. Men become stupid under its use, and gradually pass into a deep, heavy sleep.

This deadly drug takes away the appetite, im-

pairs digestion, interferes with the action of all the organs of the body, and powerfully affects the will. The opium eater will sacrifice anything to get his favorite drug. He loses all sense of honor and truth, and nothing is too valuable for him to part with, if only it will procure him his favorite drug.

None Escape.—No one who uses opium escapes its bad effects. It appears to affect all alike, weakening both body and mind. Some people foolishly imagine that they can use alcohol in moderate quantities without suffering its ill effects. We have seen that this is impossible. In the use of opium there is no such thing as "moderation." The fearful craving for the drug leads its victim on to greater and greater excesses.

The Physician can Detect the Opium Habit.—Its effects on the body—as shown by the listless eye, the stooping figure, and the discolored skin—enable the trained eye of the physician to detect the opium user with almost unfailing accuracy.

Its Terrible Power.—The power of opium to injure the body is terrible enough; but when we consider that it will weaken and break down the higher part of our natures, even our sense of right and wrong, then we wonder how anybody of sane mind can allow himself to become a victim to its use.

CHAPTER XXXI

TEA, COFFEE, TOBACCO

Tea and Coffee.—The value of tea and coffee is doubted by many wise physicians. It is certain that all young people would be a great deal better off without them.

Bad Effects.—If the coffee be taken late in the day, it is likely to prevent sleep; and the use of strong tea continued for a long time is likely to cause nervousness and dyspepsia.

Neither strong tea nor coffee can be used for any length of time in large quantities without bad effects on the system. Their use by the young is likely to cause stomach troubles, headaches, nervousness and wakefulness.

History of Tobacco.—When Columbus, in 1492, landed on the island of Hayti, he sent out his men in all directions to see what they could find in the new country. In a short time some of them returned to the ship and told him that they had seen men who appeared to follow a very singular practice. They carried tubes in their mouths, into which they would put some kind of weed, and setting fire to this, they would blow the smoke through their mouths and nostrils.

Its Introduction Abroad.—In the year 1587 Sir Walter Raleigh sent a company of men to Virginia. When they returned they brought to him two vegetables,—the potato, and tobacco. Sir Walter procured a pipe, tried the tobacco, and soon became very fond of it; but for some reason he kept his use of it a secret.

Efforts to Stop Its Use.—Soon tobacco was being used to a large extent, and many of the wisest men of England feared some of the evils that have resulted from the use of such a powerful drug. James I., who was then king, therefore caused a heavy tax to be placed on tobacco, trying thus to limit its cultivation. He even wrote a book on its use, in which he said that smoking was a practice "loathsome to the eye, hateful to the nose, harmful to the brain, and dangerous to the lungs." A little later the Russian Government tried to prevent smoking, with the penalty of the loss of the nose if a person were caught using tobacco; and the Sultan of Turkey punished with death all smokers and snuff takers. But the rulers of that day soon found that all they could say or do did not check the practice, which was steadily on the increase; so they contented themselves with levying a tax, thus enriching themselves at the expense of those who persisted in the use of tobacco.

Nicotine.—The poisonous substance in tobacco is called nicotine. An English writer on poisons,

Wynter Blythe, says: "Poisoning by nicotine pure and simple is rare. Tobacco poisoning is very common and has probably been experienced in a mild degree by every smoker in first acquiring the habit. Children have been poisoned from playing with old pipes. A three year old child once blew soap bubbles for an hour with an old tobacco pipe. Soon after symptoms of poisoning set in and in three days the child died." Tobacco is so injurious to insect life that it is used in various forms as a liquid, smoke, or powder to destroy insect pests.

Effects on Vegetables.—Tobacco seems also to destroy all forms of vegetable life. If plants be placed in a room in which there is a strong odor of tobacco, as in tobacco factories, or in tobacco drying-rooms, they will gradually droop and die.

The General Verdict.—The general testimony is that nicotine is one of the most deadly poisons to all forms of animal and vegetable life, and also that it is the presence of this poison in tobacco that gives it its power over those who use it.

Its First Effects.—The first use of tobacco almost invariably causes sickness. The healthy body feels its effects most keenly, and extreme weakness, nausea, and vomiting follow. If its use be continued, however, these acute symptoms disappear; but the tobacco still has its effect on the user, though this is less violent and so less evident.

Its Effects on the Young.—The effects on the body of

the adult vary greatly, according to the individual, his habits of life, etc. It is certainly true that tobacco has a much more severe effect on some than on others. It may be laid down as a rule, from which there is scarcely an exception, that its effects on all who use it before the body reaches its maturity, as it does at about twenty-five years of age, are bad; while if its use is begun earlier in life, at ten or twelve years, the effects are much more serious. As a rule, the younger the person using tobacco, the more active will its effects be.

Especially Bad for Boys.—Other things being equal, a boy who smokes or chews tobacco before he is twelve or fourteen years of age must expect to be shorter in stature, weaker in muscle, and to show less fitness in his studies than his companion who does neither.

Tobacco tends to interfere with systematic and orderly habits, and to dispose to slovenliness. It lowers the value of a boy's work so much that business men very generally choose boys who do not smoke to fill positions in their employment.

Wise Laws.—The effect of tobacco on the boys in the public schools in Paris was shown by their pale faces, weak muscles, imperfect circulation of the blood, and continued poor recitations. On account of this, the Minister of Public Instruction issued an order forbidding its use by the students.

Some of the earlier laws of New England were

wise in this respect. One ordered that no person under twenty years of age should use tobacco without first obtaining a certificate from a physician to the effect that the tobacco would be good for him.

It Shortens Life.—Dr. A. B. Palmer, who was a professor for over thirty years in the Medical College of the University of Michigan, said that "boys and young men who use tobacco lose one-fifth of the enjoyment and value, and at least one-tenth of the length, of their lives."

Exceptions do not Constitute a Rule.—It is nothing in favor of tobacco that some persons can use it without apparent bad effects, any more than it is an argument in favor of alcohol that some persons do not appear, at first, to be harmed by it.

General Effects on the Young.—Tobacco lessens the natural appetite for food and injures digestion. It irritates the mouth and throat, and frequently causes the voice to become husky and coarse. It makes the body restless and nervous, causing a peculiar sinking sensation at the stomach, which strongly tempts the smoker to try the effects of some alcoholic drink. It often causes the sight to become weak, and gives rise to ringing, buzzing noises in the ears. It affects the action of the heart, making it beat unsteadily, and leads to dizziness and rushing of blood to the head. It often disturbs the sleep with distressing dreams.

CHAPTER XXXII

LONG LIFE

It is a fact that those who never use alcoholic drinks in any form, have a prospect of living longer than those who do use them. Without doubt, some diseases are caused by alcohol, and many diseases are made worse by it. If a person has led a temperate life he will be more likely to recover from a severe illness than one who has been intemperate.

Insurance companies that keep the accounts of abstainers in a separate section from the others find that abstainers live longer than moderate drinkers. Twelve presidents of American life insurance companies have testified that the use of intoxicating drinks tends greatly to shorten life.

The claim often made that some persons who use intoxicating liquors live to be old, is no argument in favor of alcohol. How do we know that those same people would not have lived longer, and done better work in the world if they had never taken alcoholic drinks? A man may claim that he has drunk whiskey all his life, and yet is in a good state of health. Such may be the case; but to understand

the full effect of his habit one must consider his children. Of all the effects of alcohol, none are more deplorable than the suffering of children for the drinking habits of their parents. When both parents indulge freely in the use of alcoholic drinks, there is little chance that their children will escape inheriting a weak, nervous system.

CHAPTER XXXIII

THE CIGARETTE AND THE COMING BUSINESS MAN

There are many reasons why all boys who wish to become successful men should refuse to smoke cigarettes. See how many good reasons you can name in addition to the following:

1. Cigarette Smoking Lessens the Natural Appetite for Food and Injures Digestion.—Any close observer will know at once how true this statement is. The boy who smokes has a bad digestion and a poor appetite. As a result the food is not properly digested and the growth and development of the body is seriously interfered with by this early poisoning.

2. It Seriously Affects the Nervous System.—The rush of blood to the head, the dizziness, the unsteady beating of the heart, the distressing dreams—all show that the nervous system has been greatly disturbed.

More serious still is the effect on the nervous system, which produces marked changes in the mental activity. Reports from the University of Michigan, Northwestern University, Yale University and Union College, together with scores of other institu-

tions and hundreds of the most eminent teachers of the country, all testify to the fact that cigarette smoking interferes with scholarship. If it interferes with the scholarship of young men over twenty-one years of age, how much more seriously must it interfere with the mental activities of those under this age!

3. It Lowers the Moral Tone.—Another most serious charge against the cigarette is that it lowers the moral tone. Boys who would not tell a lie on any other matter, do not seem to hesitate a moment to tell any kind of a falsehood in order to keep from their parents the fact that they are smoking cigarettes. They conceal the truth, smoke away from home, and try in every way to deceive those who are nearest and dearest to them.

4. It Creates a Craving for Strong Drink.—The hot smoke from the cigarette tends to make the mouth and throat dry and creates a peculiar sinking sensation in the stomach. Water may temporarily relieve this dryness and may temporarily check the sinking sensation. But with the moral tone lowered and the mental power weakened, the tendency to yield to the first temptation is strengthened, because of the flimsy excuse that the boy must have something to wet his throat. And so the boy who smokes more easily accepts an invitation to a treat than one who does not smoke.

5. It is Expensive.—Money will purchase so many

valuable things, that it seems foolish to squander it on tobacco, which is worse than useless.

6. It is Unlawful.—In nearly every State in the Union there are stringent laws forbidding the furnishing of cigarettes or tobacco to minors under a certain age. In most of these States there are laws against selling to such minors. Take the District of Columbia, the home of our nation, and we find that 257 physicians, 524 officers and teachers of the public schools, and the trustees of the public schools, and 86 pastors of churches petitioned Congress for the passage of a bill prohibiting the selling, giving, or furnishing tobacco to any person under sixteen years of age.

The reasons why these people wished to protect boys in this way are: Tobacco makes boys lazy and dull. Close observation for many years has shown that those who are most energetic, active, alert, and quick, do not smoke; while the listless, lazy, dull, sleepy, uninteresting and uninterested boys are those who smoke.

CHAPTER XXXIV

BEFORE THE DOCTOR COMES

The knowledge we have acquired of anatomy, physiology, and hygiene should be of great assistance to us in times of emergency, when an accident renders it necessary that something should be done at once. To wait idly until the doctor comes may cost a life, while prompt and proper action will often greatly aid him, and may prevent a fatal termination to the accident. Some persons feel that they must do something, no matter what, but flurry often increases the danger, while a little cool judgment might greatly lessen it. To know what to do, and when to do it, is a great deal.

When calling a physician, always inform him of the nature of the accident, that he may bring with him all necessary appliances and remedies. Examine an injured person with great care, as rough handling may open a wound which has ceased bleeding, making it bleed afresh, or the rough handling may cause a broken bone to injure some of the soft tissues. Always give injured persons plenty of fresh air. Do not crowd about unless you can be

of use. Only those who can assist should stand near an injured man, or even remain in the same room.

Accidents.—A little court plaster, or surgeons' plaster, is a very convenient thing to have at hand when slight accidents occur. If the skin is broken or scraped, clean it thoroughly with water, dry it with a clean cloth, and place a small piece of adhesive plaster over the wound. This will greatly hasten the healing. When the skin has been cut through with a knife, or other sharp instrument, the cut should be cleansed and then the edges of the wound should be drawn closely together and held in place by strips of plaster.

Bandages.—A bandage is usually made by tearing a piece of cloth into strips, the width depending upon the part to be bandaged. For the finger, the strip should not be over three-fourths of an inch wide; for the arm or leg the strip may be two inches wide. To apply a bandage properly requires experience. It is well for boys and girls to practice with different forms of bandages, as the class in the illustration, page 182, are learning to do. Remember that the bandage should always be wound around the part as smoothly and evenly as possible. Do not put on a bandage that is wet, for when it dries it will shrink and pinch the part too tightly. In winding a bandage always begin below the injured part and wind toward it. A bandage

should be neither too tight nor too loose, but just snug, and wound as smooth as possible.

Bleeding.—Nothing is more alarming to some people than the sight of flowing blood. To check it often requires prompt action; promptness may save

PUPILS RECEIVING INSTRUCTION IN APPLYING BANDAGES

a life. Do not try to stop the bleeding by tying great quantities of clothing around the injured parts; it will soak up the blood, while the bleeding may continue beneath. If the blood comes from an artery it will flow in jets or spurts; but if it arises from a vein, the stream will be a steady one. If the bleeding comes from the surface of the body, it may gen-

erally be checked by pressure. This may be applied with the fingers; or if the wound is on the surface over a bone, a piece of cloth may be folded so as to make a small pad and held tightly pressed to the wound by a bandage. When the bleeding is slight frequent applications of cold water bandages will stop the flow.

Nosebleed.—Bleeding from the nose is very common and is usually not at all dangerous. It generally stops soon, without any treatment, but if necessary it may be checked by applying cold water to the forehead, over the nose, and at the back of the neck. One should also sit quietly and rest for a short time. When the blood clots in the nose, do not blow the clot out, but allow it to remain for a few hours. A severe case of nosebleed can often be stopped by placing the hands and feet in water as hot as can be borne.

A fall or a blow may cause nosebleed, but it is most frequently due to the bad habit some children have of picking the nose. The finger nail causes a slight break in the delicate membrane in the nose, this does not heal, and some time, when more blood than usual goes to the head, the nose bleeds.

Burns and Scalds.—Great relief will be given in cases of burns or scalds by covering them with soft linen or cotton cloth that is saturated with a solution of common soda. Put a tablespoonful of common soda in a cup of water and stir thoroughly.

Wet the cloth in this water, and place it upon the injured parts. This will generally relieve the sting and ache of the burn. For a severe burn use instead a thin paste made by rubbing some common baking soda into vaseline, or any simple form of ointment. If none of these are at hand, then try cream, or linseed oil, or even ordinary machine oil. A liniment of equal parts of sweet oil and lime water is very useful.

Choking.—Usually choking would be prevented if we eat slowly and chewed our food thoroughly. Sometimes when a mass of food or a bone is only partly swallowed, it causes a distressing cough or great difficulty in breathing. The common practice of slapping the person between the shoulders often helps dislodge the substances from the windpipe. It is frequently possible to aid in removing a foreign body from the throat by lifting the person by the heels, and slapping him between the shoulders while in this position.

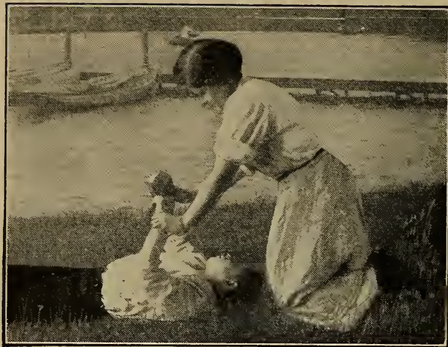
Dizziness.—Young people often have attacks of dizziness, brought about by some unusual and taxing form of play, such as rolling down hill, swinging around in a circle, or hanging from the edge of a wall. It is much better to avoid such plays, as they may be injurious. Dizziness also comes from some disturbances of the stomach, caused often by overheating, or by eating over-ripe or unripe fruit. If the stomach is relieved by vomiting the dizziness

Removing Water from Lungs

soon passes away. When an attack of dizziness comes from some simple cause, it will soon pass away if one lies down and keeps very quiet. If the dizziness should continue for some days it may be the beginning of an illness, and a physician should be consulted.

Drowning. — In cases of apparent drowning it is important that the person should have immediate attention. Every moment counts. A physician should be summoned at once, but meantime there is much that even a child can do. The first thing is to remove the water from the lungs; this may be done by catching the body around the waist and holding it, head down, first pulling the tongue forward so that it shall not fall

First Position—Artificial Inspiration



SECOND POSITION

back into the throat. Sometimes the body is rolled on a barrel, head down. Less than a minute should be given to this first step.

Then, if the physician has not yet arrived, artificial respiration should be tried. One of the simplest methods is that shown in the accompanying illustrations. The motions are as follows: Place the person on the back with a roll of clothing under the shoulders; kneel at the head, grasp the patient's arms at the elbows, draw them slowly over his head and hold them there long enough to count four slowly. This raises the chest walls and allows the air to rush into the lungs. Then push the arms down against the chest, bringing the forearms close together, and hold the arms in that

THIRD POSITION—ARTIFICIAL EXPIRATION

position long enough to count four again. This movement diminishes the size of the chest and forces the air out. Then repeat these movements. They should be continued, if necessary, for an hour or an hour and a half before the case is abandoned. Look out for the tongue, which often falls back into the throat and prevents the passage of air into the lungs. It may be necessary to have some one draw the tongue out of the mouth and hold it with a dry handkerchief.

While this treatment is being given, the lower part of the body should be covered with blankets or any warm clothing that can be secured, and hot water bottles applied to the feet and legs.

Fainting.—A person faints because, for some reason, there is not the usual amount of blood going to the brain. The treatment, therefore, should be to place the fainting person in such a position as to increase the amount of blood flowing to the brain. He should be placed at once on his back, with the head as low as the body, and should not be raised until he has fully recovered. This should be done so that the blood may flow readily through the brain. To keep the head raised high, or to maintain the body in the erect posture, may cause a fatal termination to the attack. Dashing a small quantity of water on the face, and holding an open bottle of ammonia near the nose, will perhaps aid. All clothing about the neck should be loosened. Never

give brandy or any form of alcohol in such cases; a cup of hot coffee, given as soon as the patient can swallow readily, is much better.

Fire.—When the clothing takes fire, fatal results may occur in a short time. If we see a person on fire we should instantly grasp the nearest rug, shawl, blanket, large cloak, or heavy curtain, and wrap it tightly about his body. After that is done, it is wise to roll him on the ground, and this with the blankets, will be likely to smother the flames. If no blankets are at hand, then the simple rolling on the ground may put out the fire. If you ever meet with such an accident, your first impulse may be to run around the house or into the street. But do not do this; for the result is usually fatal. In case you are alone at the moment, catch something to smother the flames, as already directed, lie down, and roll over and over.

Fractures and Dislocations.—If a bone is broken or thrown out of joint, or if this is thought to be the case, the injured part should be kept perfectly quiet, and the patient made as comfortable as possible. It is better to wait a few hours for the physician to come, than to attempt to set a broken bone, or to handle the injured parts to learn what the matter is.

Intoxication.—When insensibility arises from intoxication it is a more difficult matter to restore consciousness. As a rule, very vigorous measures

are not successful, and are often harmful. It is usually better to leave nature alone in such cases.

Poisons.—Whenever it is feared that poison has been swallowed, it is safest not to wait until the doctor comes, but to cause vomiting at once, and thus get the poison out of the stomach before it is all absorbed. Vomiting is easily caused by giving the patient a large cupful of warm water in which there has been thoroughly mixed a dessert-spoonful of ground mustard. If this does not cause vomiting in a few minutes, the dose may be repeated. A tablespoonful of alum dissolved in a pint of warm water taken at once may be effective. Aid the drugs by thrusting the finger down the throat. After the vomiting it is best to give a glass of milk to which the well beaten whites of two eggs have been added.

Shock.—Sometimes persons become insensible in consequence of a blow, or through fright, or from a fall; and yet none of these causes may be severe enough to injure any organs or tissues. As a rule it is only necessary to place the person on his back and give him plenty of fresh air. If the head is hot, a cloth moistened with cold water may be applied to it.

Sprains.—Sprains are oftentimes of a serious nature. Recovery from them is usually slow, and sometimes the joint is left stiff. Sprains should be

bathed in either hot or cold water, whichever gives the greater relief.

Sunstroke.—In cases of sunstroke the skin and head are usually very hot, and there may be partial or complete unconsciousness. Remove the patient to a cool place, lay him on his back, with the head slightly raised, apply cold cloths or ice to the head, at the same time bathing the face and head with cold water. Do not neglect to send for a physician at once.

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